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Sex of Subject and Cognitive Style as Predictors of Successful Biofeedback Performance

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SEX OF SUBJECT AND COGNITIVE STYLE
AS PREDICTORS OF SUCCESSFUL BIOFEEDBACK PERFORMANCE

by

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VITA

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CHAPTER I

INTRODUCTION

The debate over whether EMG biofeedback is an effective treatment modality for relaxation has raged for many years(e.g., Astor, 1977; Simkins, 1982). Research addressing this issue has typically been directed at evaluating whether EMG biofeedback is more effective at facilitating relaxation than a control condition or than other types of relaxation treatments(e.g., progressive relaxation, systematic desensitization, hypnosis). An observation that is frequently made is that the results from this research are contradictory. One group of studies(e.g., LeBoeuf, 1980a; Andrasik & Holroyd, 1980; Coursey, 1975; Kondo & Canter, 1977) has demonstrated that EMG biofeedback treatment is superior to other relaxation techniques at aiding subjects to relax. There is, however, an equally large body of literature(e.g., LeBoeuf, 1980b; Shedivy & Kleinman, 1977; Glaus & Kotses, 1979; Hart & Cichanski, 1981) which concludes that EMG biofeedback treatment, though effective, is no more effective at producing relaxation than other, less expensive, relaxation training procedures.

In light of these conflicting results, research efforts have been directed away from the global issue of whether or not biofeedback is an effective relaxation technique and towards an investigation of those individual differences which might effect response to biofeedback treatment. One individual difference variable of potential value is the sex of the subject receiving treatment. Most studies employ subjects of only one sex and have not concerned themselves with how sex of the subject might relate to ability to use biofeedback. In the few studies that have reported employing subjects of both sexes, the results have been inconclusive but suggestive of possible sex differences in ability to benefit from biofeedback training.

Another area of individual differences that also has received comparatively little attention in biofeedback research is that of cognitive style or problem-solving ability. Cognitive style has been proposed as a construct to explain the activities that occur between receiving a stimulus and activating a response(Goldstein & Blackman, 1978). Cognitive style is a person's characteristic way of organizing and integrating the information that he/she receives from the environment. In those few instances when a cognitive style has been considered as a potential mediator of response to biofeedback, a relatively simplistic approach has been taken. That is, different levels on a single cognitive style dimension are studied while the researcher takes measurements on the dependent variable(e.g., EMG level in biofeedback). Cognitive styles, in addition to locus of control(Rotter, 1966) and field dependence-independence(Witkin, Dyk, Faterson, Goodenough, & Karp, 1962), which can be examined are reflection-impulsivity(Kagan, 1965), verbalizer-visualizer(Richardson, 1977a), flexibility-rigidity(Breskin, 1968), and high-low levels of self-absorption(Tellegen & Atkinson, 1974). There has been little concerted effort on the part of researchers to take combinations of these cognitive styles and other personality characteristics and determine which combination(s) can best predict EMG biofeedback performance.

The present study was designed to examine individual differences in response to EMG biofeedback training for relaxation purposes. Specifically, one aim of this study was to examine the aforementioned cognitive styles and find which combinations, if any, could be utilized to predict successful subject response to EMG biofeedback training. A second aim of this study concerned sex of subject and whether it was an important predictor variable in EMG biofeedback training.

CHAPTER II

REVIEW OF THE LITERATURE

The majority of the biofeedback research has been concerned with the question of whether or not biofeedback is an effective treatment modality (e.g., Astor, 1977; Simkins, 1982; Tarler-Benlolo, 1978) and whether it is more effective than other treatment modalities (i.e., progressive relaxation, noncontingent feedback, verbal instructions to relax, etc.) at getting people to relax(Surwit & Keefe, 1978; Orne, 1979). Additional questions in the area of EMG biofeedback focus on whether reductions in EMG level due to biofeedback training generalize to other muscles and whether these reductions in EMG muscle tension level are reflected in subjects' reports of relaxation level.

EMG Biofeedback as a Relaxation Technique

Reflecting the immense interest surrounding the effectiveness of EMG biofeedback as a relaxation technique is the large body of research in this area. One strategy for assessing EMG biofeedback has been to compare the performance of subjects receiving biofeedback to that of subjects receiving noncontingent or false biofeedback. In one such study, LeBoeuf(1980a) found that female nursing students who received contingent biofeedback demonstrated a marked decrease in EMG activity in the training session when compared to nursing students who received noncontingent biofeedback and who showed no change in EMG activity. Kondo and Canter(1977) treated 20 subjects suffering from tension headaches with frontalis EMG biofeedback. Ten of the subjects received contingent EMG biofeedback while the other ten subjects received false(noncontingent) biofeedback. The group of subjects receiving the contingent biofeedback showed significant decreases in both EMG level and the number of headaches reported in comparison to the noncontingent feedback group. While the subjects receiving noncontingent biofeedback exhibited some decrease on both of these variables, neither was significantly less than initial baseline. LeBoeuf(1980b) assigned subjects to one of three groups(contingent frontalis EMG biofeedback, noncontingent biofeedback, and verbal instructions to relax) in order to determine which method would be most successful at helping subjects to relax. The results showed that contingent EMG biofeedback was more effective than either the noncontingent biofeedback or verbal instructions to relax at lowering frontalis EMG levels.

Many of the studies in this area compare EMG biofeedback and a no-biofeedback control condition in order to determine the relative efficacy of EMG biofeedback treatment. Coursey(1975), in one of the earlier studies in this area, found that EMG biofeedback was more effective than verbal instructions to relax at aiding subjects to reduce EMG muscle tension. Andrasik and Holroyd(1980) examined the response of headache sufferers to EMG biofeedback treatment or a control manipulation. They found that the group receiving the EMG biofeedback treatment was more successful at both alleviating headache symptoms and decreasing EMG muscle tension level than the control group. Alexander, French, and Goodman(1979) investigated the effects of different types of feedback(auditory vs. visual) and a control condition on the ability of subjects to relax. Subjects who were given auditory EMG biofeedback exhibited greater decreases in EMG levels than either the visual biofeedback group or the control group. Kinsman, O'Banion, Robinson, and Staudenmayer(1975) found that subjects who received EMG biofeedback improved(exhibited reduced muscle tension levels with regard to their initial baselines) consistently throughout the ten session study and were more successful at relaxing than the verbal feedback group or the control group. Similar results were also reported by Haynes, Moseley, and McGowan(1975). Finally, both Hart and Cichanski(1981) and Sagberg and Kviem(1981) found frontalis EMG biofeedback to be as effective as EMG biofeedback to other muscle sites(neck or forearm) at reducing EMG muscle tension level.

In a comprehensive evaluation of EMG biofeeedback, McGowan, Haynes, and Wilson(1979) examined the effect of EMG biofeedback on four variables: 1)frontalis EMG level, 2)frontalis response to stress, 3)cardiovascular variables, and 4)cardiovascular response to stress. Their stress test involved having subjects visualize a fear situation. Subjects were assigned to either a frontalis EMG biofeedback group or a group receiving only instructions to relax. Following a treatment period, subjects were exposed to the stress test which was followed by an adaptation period during which they 'recovered' from the stressor. The positive results of this study center on the observations that, in comparison to the group receiving instructions to relax, the group receiving frontalis EMG biofeedback exhibited significantly lower resting levels of frontalis EMG and lower levels of frontalis EMG in response to stress.

While the array of studies testifying to the efficacy of EMG biofeedback is impressive, there is also a large body of literature which asserts that EMG biofeedback is inferior to, or no more effective than, other types of relaxation treatments, or to control conditions. With these studies, if EMG biofeedback is not found to be superior to or add to other relaxation techniques, this casts doubt on the value of EMG biofeedback as a relaxation technique. The majority of the studies producing the negative results have compared biofeedback to other treatments on the ability to aid relaxation or reduce some type of anxiety state.

In an examination of different relaxation techniques, Reinking and Kohl(1975) compared EMG biofeedback alone, Jacobsen-Wolpe relaxation instructions, EMG biofeedback plus Jacobsen-Wolpe relaxation instructions, and EMG biofeedback plus monetary reward. Their results indicated that EMG biofeedback did not add significantly to the relaxation level which is obtained by using the Jacobsen-Wolpe relaxation instructions alone. Another comparison of different relaxation techniques was performed by Raskin, Bali, and Peeke(1980) in assessing the merits of

EMG biofeedback, transcendental meditation, and relaxation therapy in treating chronic anxiety. This was one of the longer studies in that it included a 6-week baseline, 6 weeks of treatment, and a 6-week post-treatment observation and follow-up. Thirty-one subjects completed the treatment process and there were no significant decreases between the three treatments on the following three criteria: 1)treatment efficacy, 2)symptom amelioration, and 3)maintenance of therapeutic gains. The authors concluded that there was no evidence to suggest that the degree of muscle relaxation associated with any particular treatment was directly related to the therapeutic outcomes and that all three treatments have equal merit in the treatment of chronic anxiety.

Beiman, Israel, and Johnson(1978) compared live and taped progressive relaxation, self-relaxation, and EMG biofeedback in terms of their ability to reduce autonomic and somatic arousal along with self-reports of tension. Forty subjects received five sessions in one of the treatment groups(ten subjects/group). Measures were taken on progress in relaxing both during treatment and after treatment. Live progressive relaxation was superior to taped progressive relaxation in reducing physiological arousal while self-relaxation and EMG biofeedback were equivalent in reducing arousal during training. At follow-up, live progressive relaxation was superior to all other treatments in reducing arousal and self-reports of tension.

Sime and DeGood(1977) demonstrated that EMG biofeedback was significantly better than a control condition at aiding subjects to relax but the EMG biofeedback was no more effective than progressive relaxation. Support for this conclusion came from Miller, Murphy, and Miller(1978) who worked with clients who had considerable levels of dental anxiety. Their results indicated that both progressive relaxation and biofeedback led to significant reductions in anxiety but the two methods were not different in their ability to bring about relaxation.

Counts, Hollandsworth, and Alcorn(1978) examined effects of biofeedback and relaxation on test anxiety. They found that relaxation alone was effective in reducing test anxiety and EMG biofeedback did not significantly add to the relaxation alone condition. A study by Romano and Cabianca(1978) also focused on the reduction of test anxiety but the treatments involved were EMG biofeedback and systematic desensitization. In their treatment program, the four groups were EMG biofeedback plus systematic desensitization, systematic desensitization alone, EMG biofeedback alone, and a no-treatment control. All subjects were identified as test anxious and participated in a 5-week treatment program. The results indicated that EMG biofeedback plus systematic desensitization, EMG biofeedback alone, and systematic desensitization alone were all effective and superior to the no-treatment control in reducing test anxiety. There were no significant differences between the treatments in their ability to reduce test anxiety.

Finally, Alexander, White, and Wallace(1977) found no difference between EMG biofeedback and a control condition at aiding relaxation when the level of motivation is maintained across conditions. They pointed out that, sometimes, control subjects lose their motivation to perform and this may account for the observed differences between control subjects and those receiving EMG biofeedback or progressive relaxation.

After reviewing these studies, it is apparent that there is no clearcut answer to the question of whether or not EMG biofeedback is effective at aiding relaxation. Furthermore, there is no unequivocal evidence that EMG biofeedback treatment is more effective than other modes of treatment for producing relaxation in subjects.

A further question of some importance when considering whether or not EMG biofeedback is an effective relaxation technique is whether reductions in EMG muscle tension in one muscle group generalizes to other untrained muscle groups. This would appear to be a logical step since, to be of maximum benefit, a relaxation treatment must aid or produce a state of relaxation in the entire body and not solely in component parts of the body. Therefore, an index of this generalized relaxed state would be the relaxation of muscles other than those receiving the relaxation treatment.

Alexander(1975) investigated the assumption that biofeedback can be utilized as a general relaxation technique. He found that, while subjects could significantly lower EMG muscle tension level with biofeedback, there was no reduction in EMG level of other muscles which should occur in a generalized relaxed state. In their study on frontalis EMG biofeedback and cardiovascular response to stress, McGowan et al.(1979) found that reductions in EMG muscle tension level appeared to be applicable only to the group of muscles treated(frontalis) since there was no change in either the cardiovascular variables or the cardiovascular response to stress. LeBoeuf(1980b) showed that contingent biofeedback was no more effective than noncontingent biofeedback or verbal instructions to relax at lowering EMG levels at sites other than the frontalis muscle. These results appeared contrary to the belief that training frontalis muscles to relax can lead to a generalized state of relaxation involving other physiological systems.

Shedivy and Kleinman(1977) also found that decreases in EMG activity neither caused generalized relaxation in other muscles nor correlated highly with reports of relaxation elicited from subjects. Glaus and Kotses(1979) also failed to provide support for generalization of relaxation during EMG training. Along these same lines, Whatmore, Whatmore, and Fisher(1981) looked at the basic question of whether frontalis activity could be assumed to be a reliable indicator of activity in other muscle groups. They placed electrodes over antagonistic muscle groups on the forehead, jaw-throat area, right forearm, and the left leg. Their results, in the form of correlations between pairs of muscle groups, indicated that there was very weak evidence to conclude that activity in the frontalis muscle is correlated with and predictive of activity in these other muscle groups. Strong correlations would have indicated greater predictive ability of the frontalis muscle in terms of level of muscle activity in other muscle groups.

Thompson, Haber, and Tearnan(1981) reviewed the literature concerning generalization of EMG biofeedback to other muscle groups in an attempt to arrive at a conclusion regarding whether EMG biofeedback is effective as a general relaxation procedure. In evaluating the research, they set the following two preconditions for a study to be considered as demonstrating generalization of EMG biofeedback training: 1)feedback must produce reliable changes in the targeted muscle groups, and 2)tension level covariation between trained and untrained muscle groups must be shown to result directly from conditioning of the targeted muscle group. On the basis of this review, they stated that none of the studies reviewed support the hypothesis concerning generalization of relaxation from the frontalis to other muscle groups. Furthermore, they concluded that data exist which suggested a lack of generalization even to adjacent muscle groups.

It can be concluded from this examination of individual studies and from Thompson's et al.(1981) review of the literature that relaxation of one muscle (e.g., frontalis muscle) group does not lead to a generalized relaxed state. There is little to conclude that there is generalization of relaxation from one muscle group to an adjacent group. Therefore, regardless of whether or not EMG feedback is an effective relaxation treatment for a specific muscle group, the end result is not a generalized state of relaxation in subjects.

The question of whether subjects experience reductions in subjective anxiety levels is equally critical in evaluating the effectiveness of EMG biofeedback as a relaxation technique. Coursey(1975) noted that relaxation self-reports of subjects receiving EMG biofeedback did not differ from those of subjects receiving instructions to relax. However, the self-reports confirmed the fact that all groups exhibited reductions in anxiety level but the EMG biofeedback group did not do better than the other groups. Alexander(1975) also found that subjects who received biofeedback did not report significantly greater levels of relaxation when compared to subjects not receiving biofeedback. Reinking and Kohl(1975) found that, regardless of type of treatment and level of physiological relaxation, all groups reported increased relaxation levels. There was, however, no significant difference in subjective report of final relaxation level between the groups. LeBoeuf and Lodge(1980) noted neither a significant reduction in anxiety level nor any difference between progressive relaxation and EMG biofeedback groups in self-report level of anxiety.

LeBoeuf(1980a), in a comparison of noncontingent versus contingent EMG biofeedback, found that, even though the group receiving contingent biofeedback had significantly lower muscle tension level, both groups reported increases in relaxation level. There was no significant difference between the groups in final reported level of relaxation. Neither Romano and Cabianca(1978), Alexander et al.(1977), nor Miller et al.(1978) were able to detect significant differences in self-reported anxiety between groups receiving EMG biofeedback and other treatment modalities(e.g. progressive relaxation and/or systematic desensitization). As previously noted, all groups did exhibit some reductions of anxiety level in comparison to their initial baseline levels.

These results indicate that, for the most part, subjects receiving EMG biofeedback treatment report reductions in subjective level of anxiety or increases in relaxation level. However, this effect is not unique to EMG biofeedback treatment since other treatment groups also exhibit similar changes in self-reports. Additionally, the final levels of anxiety or relaxation for subjects receiving biofeedback were not significantly different from the levels reported by subjects receiving other treatments(i.e., progressive relaxation and systematic desensitization) or a noncontingent biofeedback control condition.

In summary, studies examining the effectiveness of EMG biofeedback as a relaxation technique have produced mixed results. Although a number of studies have demonstrated the effectiveness of EMG biofeedback for reducing muscle tension and anxiety-related symptoms, others have not shown biofeedback to be more effective than no treatment or than other relaxation techniques. There is also contradictory evidence concerning the generalization of the effects of frontalis EMG biofeedback to other muscle groups and to self-reported anxiety.

It is apparent that the debate over whether or not EMG biofeedback is an effective treatment modality could continue for years to come. With the recognition that biofeedback treatment is not for everyone, there has been a shift in the focus to one which places emphasis on those personality characteristics which can differentiate successful biofeedback users from unsuccessful ones. Among those areas beginning to be studied are individual differences such as client sex, diagnostic category, personality characteristics defined by scores on objective personality tests, and a dimension known as cognitive style.

Sex Differences in Response to Biofeedback

The sex variable, subject or experimenter, is one which has received little attention in the area of biofeedback research. It appears that the subjects used in studies are chosen in terms of their availability rather than with their sex in mind. Many experimenters, thus, seem to share the attitude of LeBoeuf(1980a) who stated "there is no evidence that the sex variable has been of any great significance in previous work of this nature." The main drawback to such a statement is that a review of the literature shows that very few studies have included subjects of both sexes and, where both males and females were included, even fewer studies report data on the main effect of sex of subject. Therefore, at this time, there are little concrete data to demonstrate that subjects' sex is related to the ability to use biofeedback.

O'Connell, Frerker, and Russ(1979) examined subject sex effects in addition to investigating feedback modality effects on biofeedback performance. Their results indicated that there was no sex difference when considering performance with visual feedback. Males did slightly, although not significantly, better than females with tactile feedback. Their conclusion was that the general pattern of results indicated that males performed better than females with biofeedback. This must be qualified, however, since the large difference between the sexes with tactile feedback seemed to influence the pattern of the results. An unpublished study(Rupert, Baird, and Tetkoski, Note 2) also reported a relationship between sex of subject and ability to use biofeedback in which females were able to use biofeedback better than males. The male subjects in this study reduced EMG activity with or without biofeedback. There was a difference in the female subjects' relaxation patterns depending on whether or not they received biofeedback; i.e. females receiving biofeedback were better able to relax than females who did not receive biofeedback.

In the other published study examining the effect of sex of subject, Malec, Sipprelle, and Behring(1976) did not find any sex differences with regard to ability to use biofeedback. They did find, however, that subjects tested by a male experimenter seemed to reduce EMG activity more than subjects tested by a female experimenter.

This review of studies demonstrated rather well that there is little systematic investigation of the subjects sex variable in biofeedback research. It also pointed out that, with the research that examined subject sex effects, there are no data on which a final decision can be based. There is no consensus as to whether subject sex is an important variable for this type of research or whether is should be ignored altogether.

Personality Variables and Response to Biofeedback

There has also been some work in this examining the ability of clients in different diagnostic categories and with different personality profiles to successfully use biofeedback. An investigation has been undertaken by Blue and Blue(1979) in which four groups of subjects (manic, agitated, depressed and control) were administered EMG biofeedback for 14 sessions. They found that manic and agitated patients were able to reduce EMG readings significantly more than the depressed or the control group subjects. These results are in line with what would be expected of manic and agitated patients since they generally exhibit a higher level of activity and muscle activity than depressed patients. Since the groups were not equated on EMG level prior to treatment, it is impossible to conclude that the decreased EMG readings of manic and agitated patients were due only to biofeedback treatment and not to the fact that their pre-test readings were initially higher than all other groups.

Page and Schaub(1978) employed MMPI profile configurations as a means to assign subjects to groups. One group contained tense and anxious subjects while the other group contained a heterogeneous sample of personality groups. They found that the anxious neurotic subjects responded best to the biofeedback treatment for relaxation. They exhibited the highest EMG levels in the control condition but had the lowest EMG levels in the biofeedback treatment condition.

Another study along these lines(LeBoeuf,1977) concerned biofeedback training with introverts and extraverts. In terms of subjective anxiety experienced by the subjects, the introverts showed a significant decrease while the extraverts demonstrated no significant decrease in anxiety. The data, however, indicate that both the introverts and the extraverts are able to significantly decrease EMG level while using biofeedback.

Cognitive Style and Biofeedback Response

One type of personality variable which has received limited attention in the biofeedback literature is that of cognitive style. Part of this lack of systematic study has to be due to the absence of an accepted definition of cognitive style. Goldstein and Blackman(1978) have defined cognitive style "as a hypothetical construct that has been developed to explain the process of mediation between stimuli and response." This definition implies that cognitive style can act as an organizing and integrating system for information that the individual receives from the environment. Among the dimensions of cognitive style most often mentioned are: locus of control(Rotter, 1966), reflection-impulsivity(Kagan, 1965), field dependence-independence(Witkin, Dyk, Faterson, Goodenough, & Karp, 1962), verbalizer-visualizer(Richardson, 1977a), and flexibility-rigidity(Breskin, 1968).

From a conceptual point of view, it is extremely hard to view people as having only one of the defined cognitive styles(e.g. impulsivity). Rather, a more useful conceptualization of cognitive style would include a provision that states that each person possesses a constellation of traits which, taken together, comprise what is called cognitive style. Such a conceptualization of cognitive style would allow for a degree of adaptability on the part of the subject. This idea of cognitive style seems to coincide with Goldstein and Blackman's(1978) definition of cognitive style as a construct to organize and integrate information from the environment and mediate the individual's response to that information. However, the main body of the literature in this area deals with cognitive style as a trait rather than a constellation of factors that come together to comprise a cognitive style. Therefore, the studies cited were designed to relate specific cognitive style variables to EMG biofeedback training and performance.

Locus of Control. Locus of control(Rotter, 1966) is one personality dimension placed under the rubric of cognitive style that has received considerable attention in the biofeedback literature. A person with an internal locus of control believes that he/she exercises control over his/her own life while someone with an external locus of control feels that fate, chance, or powerful others determine outcomes. The object of this research is usually to determine whether internally or externally oriented people respond best to biofeedback treatment. Hurley(1980), Herzog(1976), Modell(1977), and Stephenson, Cole, and Spahn(1979) all found no differences between internally and externally oriented people in their response to EMG biofeedback relaxation training. Stern and Berrenberg(1979), on the contrary, found that externally controlled subjects responded better to EMG biofeedback training than did internally controlled subjects. Finally, both Carlson(1977) and Reinking, Morgret, and Tamayo(1976) noted that internally oriented subjects responded better to EMG biofeedback treatment than subjects with an external orientation.

Ollendick and Murphy(1977) attempted to separate the cognitive and muscular components of the relaxation process while relating them to locus of control. Subjects(18 internally- and 18 externally-oriented females) were randomly assigned to either the cognitive or muscular relaxation treatment group. The target response of the relaxation procedure was the reduction of heart rate. The authors reasoned that an internally controlled client would prefer a treatment which allowed for personal control of the treatment while external subjects would require more structure and guidance in treatment. Therefore, it was hypothesized that internals would exhibit a better response to the cognitive relaxation treatment than the externals while the opposite would be true for the muscular relaxation procedure. The results were in line with the hypotheses in that, among internals, the cognitive relaxation procedure produced a decrease in both heart rate and subjective distress. Externals who received muscular relaxation treatment were able to decrease both heart rate and subjective distress.

Bourgeois, Levenson, and Wagner(1980) investigated both locus of control and field dependence-independence as predictors of biofeedback performance. In this study, locus of control was assessed by Levenson's

Locus of Control Scale(1974) rather than by Rotter's(1966) Internal-External Control Scale. Four groups were established: field-independent internals, field-dependent externals, field-dependent internals, and field independent extenals. The results indicated that there were no significant main effects for either locus of control or field dependence-independence in ability to use biofeedback treatment.

A review of the literature on locus of control and biofeedback by Zimet(1979) addressed the issue of predicting biofeedback performance from locus of control. Zimet's review noted the inconsistencies in this research and concluded that, if a highly structured framework is provided for externally controlled subjects and a loosely structured one is available for internals, EMG biofeedback treatment has the potential to be equally effective for both groups. The question remains of whether the biofeedback situation can tolerate such modifications and still maintain its fundamental characteristics as a relaxation treatment.

At this point, it is impossible to draw a conclusion as to whether locus of control influences the ability to use biofeedback. While some studies reported support for the conclusion that externally controlled subjects are better able to use biofeedback, another group of studies shed some doubt on that conclusion. These studies report that internally controlled subjects do better or there is no difference between the two groups on ability to use biofeedback.

Field Dependence-Independence. Another cognitive style to consider is field dependence-independence. People with different levels of field dependence-independence also differ in the way that they organize the world and approach problems. Field independent people possess an ability to overcome the perceptual field while field dependent people tend to be constrained by the global aspects of the stimulus situation(O'Leary, Calsyn, & Fauria, 1980). As was previously mentioned in the section on locus of control, Bourgeois et al.(1980) did not find any difference in biofeedback performance based on the level of field dependence. David and Glicksman(1976), in a study involving field dependence and a problem-solving task, found that the field independent subject were better able to disembed themselves(or ignore the constraints of the perceptual field) than field dependent subjects. It is apparent that field independent subjects are better able to overcome the perceptual constraints of a situation than are field dependent subjects. However, since people receiving biofeedback treatment must attend to very specific instructions and stimuli, a person who does not habitually attend to the specific aspects of such situations(i.e., a field independent person) might be at a disadvantage in the biofeedback situation. A field dependent person, on the other hand, might be better able to profit from biofeedback treatment due to the fact that they routinely attend to the specific cues of a situation.

Absorption Capacity. Another personality variable that could be termed a cognitive style is that of absorption(Tellegen & Atkinson, 1974). Absorption relates to the level of inner-directed attention that the subjects exhibit. Briefly, a person with a high level of absorption demonstrates a high capacity for this inner-directed attention while people with low levels of absorption have little or no capacity for this inner-directed attention. Qualls and Sheehan(1979), in a study examining the differences between subjects with high and low levels of self-absorption, found that subjects with low levels of self-absorption were better able to benefit from EMG biofeedback treatment than subjects classified as having a high level of self-absorption. The explanantion given for this effect was that the subjects with low levels of self-absorption were not manifesting inner-directed attention and could attend to biofeedback. However, subjects with high levels of self-absorption already possessed the ability to direct their attention inward and found biofeedback to be a distraction which interfered with their normal attentional processes.

In an extension and replication of their earlier study, Qualls and Sheehan(1981a) examined level of absorption capacity and level of imagery of subjects undergoing a biofeedback relaxation task. Their results indicated that subjects with low levels of self-absorption demonstrated was no significant difference (EMG levels) between the biofeedback alone and the biofeedback plus imagery instructions groups. Both these groups demonstrated significantly greater reductions in EMG level than the no-biofeedback group.

The subjects with high levels of self-absorption exhibited a markedly different pattern of results across sessions. Those in the biofeedback plus imagery group had significantly greater reductions at an earlier stage of training than the biofeedback alone group. However, by the end of training, both the biofeedback alone and the biofeedback plus imagery groups were exhibiting reductions in EMG levels that were roughly equivalent. Qualls and Sheehan(1981a) concluded that this supported their original position. They reasoned that imagery instructions to the subjects high in self-absorption allowed them to utilize their normal attentional processes(allowing for the spontaneous and unconstrained flow of attention) to relax to a level which, initially, surpassed that attained when no imagery encouragement was provided. It was expected that the imagery instructions would not be a factor in aiding subject low in self-absorption to relax and this was the case.

Qualls and Sheehan(1981b) felt that the key to this phenomenon was the attentional processes of the two groups of subjects involved(subjects high and low in self-absorption). When given specific instructions on what to attend to in the biofeedback situation, those low in self-absorption in an attentional demand group did as well as a group given biofeedback and both groups did significantly better than a no-biofeedback group. For the subjects high on self-absorption, biofeedback interfered with their ability to relax and a similar effect was noted when they were given specific instructions on what to attend to while attempting to relax. The interference became more noticeable when the demands for the subjects' attention were increased.

Expectancy of Success. Expectancy of success appears to be another cognitive style variable which can mediate a person's response to biofeedback training. Fibel and Hale(1978) have defined expectancy of success as a belief that he/she will be able to attain desired goals in most situations in which they find themselves.

Although no studies have attempted to examine the expectancy for success as a general trait which might influence performance on a biofeedback task, many studies have manipulated the expectancy regarding the outcome of biofeedback treatment. Carlson and Feld(1981) examined the expectancies that subjects have during the biofeedback training as related to their subsequent success and failure to learn to use biofeedback to relax. Expectancies of success and failure were manipulated by giving groups different types of feedback which led them to believe that they either succeeded or failed at a task prior to the biofeedback training. The group receiving the failure feedback was best able to reduce EMG levels during biofeedback training relative to the success and control groups. However, the initial EMG levels of the failure group were slightly higher than either the success or control groups. Furthermore, the self-statements of the failure group reported more frustration and lack of control than the other two groups. Since the failure group did reduce EMG levels the fastest and did not seem to be adversely effected on a subsequent task, the authors concluded that the performance was situation-specific and was not related to any generalized expectancies. Even though the failure group experienced difficulty in a given test situation, this difficulty did not generalize to either the biofeedback training or a cognitive task. It could also be interpreted that the failure group, in an attempt to compensate for their failure, worked harder during the biofeedback and cognitive tasks than would normally have been the case.

Bradley and McCanne(1981) examined subjects' relaxation responses on heart rate following the manipulation of their expectancies for treatment outcome. Following the inducement of either a positive or negative expectancy, all subjects viewed a stressful film. Although the expectancy scores of the positive expectancy group were significantly higher than those of the negative expectancy group, they were not significantly different from the control condition. Their results indicated that the subjects given the positive expectancy for treatment had the lowest heart rates both prior to and during the stressful film. The negative expectancy subjects had the highest heart rates with the control group manifesting heart rate levels that were intermediate between the levels manifested by the positive and negative expectancy groups.

In another study focusing on the expectancy for fear reduction in treatment, Borkovec and Sides(1979) compared the treatment responses of subjects given positive or neutral expectations for treatment. Their results indicated that expectancy had little or no effect on treatment outcome. Although expectancy did influence subjective and heart rate processes during treatment, with the positive expectancy group showing greater initial reaction and greater decline over repeated exposures, these effects were too brief to be expressed in any significant way in outcome improvement. Therefore, while expectancy may account for some transitory effect during treatment, these results indicate that subjects' expectancies have a negligible effect on the ultimate outcome of treatment.

The few studies in this area do not point to any conclusions regarding the effect of subject's beliefs concerning the possible effects of treatment on the actual outcome of treatment. Two of the studies(Carlson & Feld, 1981; Borkovec & Sides, 1979) conclude that subject's expectancies for treatment have no consistent effect on treatment outcome. However, Bradley and McCanne(1981) have noted that subjects' expectancies for success or failure in treatment can be directly related to treatment outcome. Subjects with a positive expectancy had the most successful treatment outcome followed by those with a neutral expectancy and, finally, subjects with a negative expectancy had the least successful treatment outcome.

It may be that, in some cases, the expectancy manipulations are not sufficiently powerful to overcome the subject's general predisposition to expect positive or negative outcomes as a result of his or her actions. An alternate approach may be to examine an individual's generalized expectancy of success as it relates to peformance on the biofeedback task.

Reflection-Impulsivity. Another cognitive style of interest is that of reflection-impulsivity. Kagan, Rosman, Day, Albert, and Phillips(1964) asserted that the reflective-impulsive cognitive style was especially applicable when response uncertainty was at a high level(i.e., there was no clear solution to the problem at hand). An impulsive person is one who tends to act initially with little reflection and processes possible hypotheses with little or no critical analysis regarding the potential accuracy of the solution. A reflective person, on the other hand, delays before acting on a possible solution, actively considers possible alternatives and compares their applicability before choosing a course of action. The reflective person wants his first solution to be as close to correct as possible. Kagan(1965), in his work on reflective and impulsive people, found that reflective people take longer to produce a response to a task and make fewer errors than impulsive individuals who work faster and make more errors. Klein, Blockovich, Buchalter, and Huyghe(1976) also found that reflective subjects performed better(made significantly fewer errors) on a problem solving task than impulsive subjects on the same task. Furthermore, Davidson and House(1978) concluded that, when compared with reflective individuals, impulsive people tend to have problems in delaying gratification, make quick decisions, show less persistence at tasks, and become easily bored if the novelty of the task is reduced. These statements are applicable to the biofeedback situation since the subject must attend to the biofeedback signal for a prolonged period of time and determine what response(s) can best lead to muscle tension reduction and a lowering of the biofeedback signal. Therefore, it would seem that reflective individuals, although taking more time initially to determine a solution, will find a solution to reducing muscle tension level that is more effective than the numerous alternate solutions that would be attempted by an impulsive individual.

Cognitive Flexibility-Rigidity. Another cognitive style variable of interest is that identified as cognitive flexibility-rigidity. A person who is cognitively flexible is able to consider a variety of behavioral options, problem-solving strategies, or solutions prior to deciding on and executing an overt response. Subjects who are classified as cognitively rigid do not possess the ability to freely consider alternative options to problem situations. Scott(1962) defined cognitive flexibility as the readiness with which the person's concept system changes selectively in response to appropriate environmental stimuli. Cosden, Ellis, and Feeney(1979), in a study of the effects of cognitive flexibility and rigidity on memory, found that cognitively flexible subjects were better able to learn memory tasks than the cognitively rigid subjects. In connection with this, Cohen, Rappoport, and Gilbert(1977) emphasized that cognitive flexibility is the ability to move from one type of processing to another in order to successfully solve problems. Gorman and Breskin(1969) also found that, in general, subjects classified as rigid performed significantly more poorly on verbal tasks than the flexible subjects. Finally, Moonie and Versey(1977) failed to find the expected differences between the rigid and the flexible subjects on problem-solving tasks. On the whole, it appears that the cognitively flexible subjects would be the better problem-solvers and, therefore, would be better able to use biofeedback in a relaxation task than would the cognitively rigid subjects.

Vividness of Mental Imagery/Verbalizer-Visualizer. In addition to the cognitive styles already mentioned, there are other cognitive style variables which, although they have not been directly related to biofeedback, deserve attention as possible mediators of EMG biofeedback treatment. Two related cognitive styles, vividness of mental imagery and the verbalizer-visualizer dimension, are similar in that they both focus on the quality of the subjects' imaging processes. The verbalizer-visualizer dimension(Richardson, 1977a) deals with the extent that subjects think and problem solve in either visual or verbal terms. People whose primary mode of thinking is in viusal(or imaging) terms are classified as visualizers while those people who think in primarily verbal terms are verbalizers. The vividness of mental imagery cognitive style(Sheehan, 1967a) refers to the clarity and definitiveness of the mental imagery produced. This dimension dovetails with the verbalizer-visualizer dimension since it would be expected that visualizers would exhibit more vividness in their imagery than would verbalizers. Simply, people who are better able to bring to mind more vivid images are high in vividness of mental imagery while those who experience difficulty in producing clear, vivid images are low on vividness of mental imagery.

In one of the few studies directly related to imagery and EMG biofeedback, LeBoeuf and Wilson(1978) examined subjects in terms of whether they employed imagery or passive concentration in achieving a relaxed state. While both groups were equally successful at becoming relaxed, it was the group that used the imagery to achieve the relaxed state who were best able to maintain the relaxed attitude during the extinction trials that followed the training. It would appear that subjects high in vividness of mental imagery and who are visualizers would perform better on biofeedback than those subjects low in vividness of mental imagery and who are primarily verbalizers.

<u>Sentience, Cognitive Structure, and Autonomic Perception</u>. The final three cognitive style variables relevant to the current study are sentience, cognitive structure, and autonomic perception. For the purposes of this investigation, sentience and cognitive structure will be defined as they are presented in the Personality Research Form(Jackson, 1974). A person classified as being high on cognitive structure does not tolerate high levels of ambiguity or uncertainty in the information that they receive. Any actions that a person high in cognitive structure takes is most likely based on positive, concrete information rather than on guesses, incomplete data, or probabilities. Those subjects classified as being high in cognitive structure would probably find the ambiguity of the biofeedback situation intolerable while those people low in cognitive structure would probably be better able to benefit from biofeedback treatment. Persons high on the scale called sentience are viewed as being very sensate-oriented. They notice, remember, and treasure smells, sights, sounds, and the way things feel. These experiences comprise an important part of their lives. Those subjects high on sentience would probably find the biofeedback situation pleasurable and beneficial since it would enhance their normal awareness of bodily sen-

sations whereas those people low on sentience would not be as likely to benefit from biofeedback since it would present them with an input which is outside their normal sensory experience.

Finally, the autonomic perception cognitive style variable is concerned with subjects' awareness of their bodily reactions during a variety of emtional states. A person with a high level of autonomic perception will demonstrate more acute awareness of bodily reactions related to emotional stimuli than would a person with a low level of autonomic perception. In light of this conceptualization, it would be expected that those people high in autonomic perception would benefit more from biofeedback treatment than subjects low in autonomic perception.

Although these results, on the whole, imply that one end or the other of these cognitive style dimensions may be associated wit superior problem-solving performance, there have been few instances in which a group or combination of these dimensions have been used to predict biofeedback performance. On the contrary, a rather simplistic approach has been used whereby single cognitive style dimensions have been investigated for their effects on biofeedback performance. If research is to move away from this simplistic viewpoint towards a more complex conceptualization of cognitive style and biofeedback, then more complex combinations of cognitive styles should be employed as predictors of biofeedback performance.

Statement of Problem and Hypotheses

This study was designed to examine the effectiveness of EMG biofeedback for reducing muscle tension and anxiety levels with particular emphasis on individual differences related to its effectiveness. More specifically, one aim of this study concerned sex of subject and whether it was an important variable in the prediction of successful biofeedback training. A second aim of this study was to examine the aforementioned cognitive style variables and find which combinations, if any, could be utilized to predict successful biofeedback performance. It would be expected that a subject high in external locus of control, field dependency, cognitive flexibility, expectancy of success, and reflective cognitive style would perform better than subjects whose cognitive style is characteristic of the opposite end of these dimensions. In light of the above, the following hypotheses were advanced. Null hypotheses were tested at the .05 level of confidence:

Subjects receiving biofeedback with instructions to relax will exhibit lower EMG muscle tension levels than subjects receiving only instructions to relax.

There will be a significant reduction in EMG muscle tension level from adaptation period in Session 1 to the adaptation period in Session 2 for all subjects.

There will be a significant reduction in EMG muscle tension level from training period in Session 1 to training period in Session 2 for all subjects.

There will be a significant reduction in EMG muscle tension level from adaptation period in Session 1 to training period in Session 2.

Female subjects in the biofeedback condition will be better able to reduce EMG muscle tension level than female subjects in the no-biofeedback condition.

Cognitive flexibility will be directly related to ability to reduce EMG muscle tension level.

Field dependence will be directly related to ability to reduce EMG muscle tension level.

Self-absorption will be inversely related to ability to reduce EMG muscle tension level.

Visualizability will be directly related to ability to reduce EMG muscle tension level.

Vividness of mental imagery will be inversely related to ability to reduce EMG muscle tension level.

Impulsivity will be inversely related to ability to reduce EMG muscle tension level.

Sentience will be directly related to ability to reduce EMG muscle tension level.

Cognitive structure will be inversely related to ability to reduce EMG muscle tension level.

Expectancy of success will be directly related to ability to reduce EMG muscle tension level.

Autonomic perception will be directly related to ability to reduce EMG muscle tension level.

Locus of control will be directly related to ability to reduce EMG muscle tension level.

Across sessions, all subjects will demonstrate a significant decrease in cognitive anxiety.

Across sessions, all subjects will demonstrate a significant decrease in somatic anxiety.

Across sessions, all subjects will demonstrate an increase in the level of relaxation.

All subjects will demonstrate an increase in their level of general deactivation across sessions as measured by the ADACL.

All subjects will demonstrate an increase in their level of deactivation-sleep across sessions as measured by the ADACL.

All subjects will demonstrate a decrease in their level of general activation across sessions as measured by the ADACL.

All subjects will demonstrate a decrease in their level of high activation across sessions as measured by the ADACL.

There will be a significant change in the cognitive appraisal of performance from Session 1 to Session 2.

There will be a significant difference in the relaxation strategies employed by subjects receiving biofeedback when compared to subjects receiving relaxation instructions.

There will be a significant difference in the relaxation strategies employed by males as opposed to those employed by females.

CHAPTER III

METHOD

Subjects

Eighty subjects(forty male and forty female) from the Loyola University undergraduate subject pool participated in this study in partial fulfillment of an introductory psychology course requirement. All subjects received course credit as compensation for their participation in this study. There were no selection criteria for participation, other than the fact that those subjects who had prior experience with biofeedback, hypnosis, and/or meditation were excluded since they were not considered to be naive. The first eighty qualified subjects who responded to the announcement of the study were selected for participation. Subjects of each sex were uniformly assigned to feedback conditions(biofeedback or no-biofeedback) on a random basis.

Experimenters

Two experimenters(1 male and 1 female) were employed in this study. Both were graduate students with advanced standing in clinical psychology. The female experimenter trained sixteen subjects of which eight were male and eight were female. The author, in addition to being responsible for contacting and scheduling all subjects, also acted as the male experimenter and trained sixty-four subjects, thirty-two males and thirty-females.

Cognitive Style Measures

Questionnaire Upon Mental Imagery(QMI). Sheehan's(1967a) version of Betts'(1909) Questionnaire Upon Mental Imagery is a widely used measure of imagery vividness. This questionnaire consists of 7 groups of 5 statements, all of which are rated on a scale of 1 to 7 with 1 indicating a perfectly clear and vivid image of the item and 7 indicating no image at all. Individual subscale scores can be obtained by totalling up the ratings to each statement in the subscale. The total score for the questionnaire is calculated by adding up all the subscale scores. Possible scores range from 35-245 with lower scores representing more vivid imagery. White, Ashton, and Brown(1977) have presented data on Sheehan's(1967a) version of this measure with regard to reliability and validity.

With regard to the reliability data, White et. al (1977), in addition to conducting their own study on 251 subjects(89 males, 162 females), surveyed two other studies(Sheehan, 1967b; Evans & Kamemoto, 1973) which also present reliability data for this shortened version of the QMI. Sheehan(1967b) employed 62 college males and obtained a test-retest reliability coefficient of .78 with a test interval of 7 months. Evans and Kamemoto(1973) calculated a correlation coefficient of .91 with 35 male and female college students over an interval of 6 weeks. White et. al(1977) found a test-retest coefficient of .59 for their sample over an interval of 12 months. An additional finding of White et. al(1977) was that females report more vivid imagery than males.

Verbalizer-Visualizer Questionnaire(VVQ). The Verbalizer-Visualizer Questionnaire, developed to measure differences in the verbalizer-visualizer dimension of cognitive style(Richardson, 1977a),consists of 15 items which are answered True or False. The inventory is keyed such that a high score indicates that the individual is on the visualizer end of the continuum. The main impetus for the development of this inventory came from the search for a better method to measure vividness of memory images. This arose after Richardson(1977b) noted some similarities in the way subjects scored on Paivio's(1971) Ways of Thinking Questionnaire which is a strict imagery measure and Sheehan's(1967a) revision of Betts' questionnaire on which subjects must rate, for vividness, voluntarily produced memory images. It would be expected that subjects who obtain high scores on vividness of imagery would also be more likely to answer as true those statements dealing with pictorial thinking and vivid imagery experience. Likewise, subjects who score low for vividness of imagery may also be experiencing difficulty in producing memory images.

Following the construction of the questionnaire and the establishment of internal consistency(see Richardson, 1977a, p. 115-116), test-retest reliability was established over a period of 7 days with 37 subjects(20 male, 17 female). A Pearson Product-moment correlation of .92 was calculated for the males and a correlation of .91 was found for the females in the sample. When the male and female groups were combined, a Pearson r of .91 was obtained.

Construct validity was demonstrated by establishing that the measure had the ability to discriminate between visualizers and verbalizers as assessed by other imagery measures. Sixty volunteer college students(34 female, 26 male) were all administered the VVQ and classified into 2 groups: habitual verbalizers(score of 7 or less) and habitual visualizers(score of 12 or more). Vividness of voluntarily produced imagery was stronger for the habitual visualizers than the habitual verbalizers while, on the other hand, habitual verbalizers scored significantly than the habitual visualizers on those items of the WOT that loaded on the verbal factor. The subjects in the mixed group(VVQ score 8-11) all scored in the middle range between the habitual visualizers and verbalizers on both the imagery and verbal items of the WOT.

Psychological Differentiation Inventory. The Psychological Differentiation Inventory(Evans, 1969) was developed as a paper and pencil measure of field dependence(Witkin, Dyk, Faterson, Goodenough, & Karp, 1962). This inventory consists of 5 subscales, Embeddedness(global versus analytic perception), Ego Functioning(ego awareness and self identity), Social Awareness(social perception), Controls and Defenses(emotional expressiveness and use of repression), and Body Image(body articulation). Each scale consists of 9 items and is scored on a 4 point scale. A score is obtained by adding up correct answers for each subscale and a total score for the inventory is calculated by adding together all the subscale scores.

Four groups of subjects(N=60,154,45, and 27) were employed in validating the PDI against the Embedded Figures Test(Witkin, 1950). Kuder-Richardson reliabilities were computed for the 60 and 154 subject samples. The reliability coefficients are as follows: Embeddedness, .82, .88; Ego Functioning, .59, .64; Social Awareness, .51, .67; Controls and Defenses, .70, .89; and Body Image, .3 7, .67. Retest reliabilities were computed on a separate sample of 56 subjects and found to be .74, .42, .53, .54, and .67 for the respective subscales. The test-retest interval varied from a few days to several weeks. Three validity studies had sample sizes of 73, 60, and 154 and correlations of these samples with the Embedded Figures Test ranged from .46 to .76 for the total PDI and from .17 to .59 for the subscales.

Breskin Rigidity Test(BRT). Breskin(1968) developed the Breskin Rigidity Test from the assumption, derived from the Gestalt law of Pragnanz, that more rigid people will select the 'better fit' when given the opportunity to express a preference between pairs of figures whose only differences relates to 'goodness of fit'. Breskin assumed that rigid individuals required more structure in their environment than the non-rigid individual. In terms of problem-solving, Gorman and Breskin(1969) found that rigid subjects performed more poorly than flexible subjects on all tasks except one dealing with associational fluency.

Breskin(1968) constructed a test that contained 15 pairs of items which was administered to a standardization sample of 132(64 female, 68 male) college students. An odd-even reliability coefficient, corrected by the Spearman-Brown formula, was .78 while the correlation coefficient obtained from the Kuder-Richardson formula 20 was .98.

Validation procedures were performed in 3 studies. The first 2 studies compared female secretarial students(considered more rigid) with female art students(considered less rigid) and male accounting majors(more rigid) with male art design students(less rigid). The female secretarial students scored significantly higher than the females in the standardization sample while the female art majors scored lower than the standardization group. The male accounting majors scored higher than the standardization, but not significantly so, while the art students scored significantly lower than the standardization sample. In the final validity study, male and female designers were judged on level of rigidity by an independent observer(an art designer) prior to the administration of the BRT. Male subjects who had been rated as more rigid received significantly higher rigidity scores than those subjects who were rated as less rigid. There was no significant difference between those females rated as more rigid and those rated as less rigid.

Generalized Expectancy of Success Scale(GESS). The Generalized Expectancy of Success Scale(Fibel & Hale, 1978) was developed to measure a person's generalized expectancy of success which was further defined as one's expectancy that he/she will be able, in most situations, to attain desired goals. According to this view, it would be expected that individuals with a high expectancy of success have a higher behavior potential(or readiness to engage in certain behaviors) than individuals with a low expectancy of success. The test consists of 30 items which are answered on a 5 point scale(1=highly improbable, 5=highly probable) and a total score is calculated by adding up all the ratings to all the individual items.

One group of subjects(N=104) was tested at a 6 week interval on the 30 item GESS for the purpose of establishing test-retest reliability. The test-retest correlation for all subjects present for both administrations(N=74, 46 female, 28 male) was .83 overall with a .89 for males and .80 for females. After combining the 104 subject sample with a second, 103 subject sample, reliability coefficient for odd versus even items, using the Spearman-Brown formula, was calculated at .90 for females and .91 for males. The correlation between the first 15 items and the last 15 items was .82 for females and .83 for males.

Internal-External(I-E) Control Scale. This scale, designed by Rotter(1966), is designed to assess the degree to which an individual feels the reinforcements that he/she receives are contingent upon his/her own behavior. Joe(1971), in a review of the I-E control construct, stated that people with internal control believe that reinforcements are contingent upon their own behaviors, capacities, or attributes. People with an external control orientation, on the other hand, see reinforcers as not under their control but are due to powerful others, luck, fate, chance, etc. There are 29 items in the I-E control scale and it is keyed so that a high score indicates an external orientation. The scale contains 6 buffer items so possible scores can range from 0 to 23.

Rotter(1966) reported test-retest reliabilities for varying samples and time periods from 1 year to 2 months in the range of .49 to .83, respectively. Hersch and Scheibe(1967) found the test-retest reliabilities ranging from .43 to .84 for groups tested at two month intervals. They also had one group of 18 students who were administered the I-E scale one year apart and had a reliability coefficient of .72. The discriminant validity of the I-E Control Scale was also addressed by Rotter(1966).

Remote Associates Test(RAT). The Remote Associates Test(Mednick & Mednick, 1967) is a 30 item test in which each subject is presented with 3 stimulus words and must produce the fourth word that is correctly related to the three stimulus words. The total score is obtained by counting the number of correct responses and possible scores range from 0 to 30. In the manual of the RAT, Mednick and Mednick(1967) provided ample normative data for the college population.

Odd-even reliabilities have been calculated for 3 groups of college stud ents. Reliability correlation coefficients, using the Spearman-Brown formula, of .91 and .92 were calculated from two of the college student samples. The odd-even reliability calculated from the third student sample was .86 while an alternate forms reliability coefficient(comparing Form 1 with Form 2) of .81 was obtained from the same sample.

Validity was established by correlating the scores from the RAT with scores obtained on other similar measures. Twenty students were rated by an independent observer for creativity and then given the RAT with the resulting correlation being equal to .70. Forty-three psychology graduate students were administered both the RAT and a research creativity checklist with the resulting correlation between the two measures equal to .55. Other validity data concerning a wide variety of personality and achievement variables can be found in the manual of the Remote Associates Test(College-Adult Form, Mednick & Mednick, 1967).

Autonomic Perception Questionnaire(APQ). The Autonomic Perception Questionnaire(Borkovec, 1976a) was originally contained within a 28 item questionnaire developed by Mandler in the 1950's(Mandler, Mandler, & Uviller, 1958). It was designed to assess the degree that subjects noticed bodily reactions during selected emotional states. The APQ was the first 21 items of this larger questionnaire and was concerned with subjective experiences when subjects were anxious and happy. Each item is scored on a scale of 0 to 9 with 0 indicating no presence of the symptom and 9 representing definite presence of the symptom. A total score is obtained by adding up all the ratings.

The normative data, for the most part, are descriptive rather than quantitatively oriented. Borkovec(1976b) presented data indicating that females score higher than males on the APQ and that clinical subjects score higher than college student subjects. It appeared that females score higher than males on items concerned with awareness of cold hands, shallow breathing, lump in throat, upset and sinking stomach, and the bothersomeness of bodily reactions.

Personality Research Form-Form E(PRF). The Personality Research Form-Form E(Jackson, 1974) is a clinical research instrument consisting of 22 scales that assess different facets of an individual's personality. Three of the scales, Cognitive Structure, Impulsivity, and Sentience, were of specific interest to the present study. In his manual, Jackson provides a description of the prototypical high scorer on each scale along with a cluster of trait adjectives. For example, a high scorer on Cognitive Structure is described as follows: "Does not like ambiguity or uncertainty in information; wants all questions answered completely; desires to make decisions based upon definite knowledge, rather than upon guesses or probabilities." The person scoring high on Impulsivity is described as: "Tends to act on the spur of the moment and without deliberation; gives vent readily to feelings and wishes; speaks freely; may be volatile in emotional expression." Finally, the person high on Sentience is described in this way: "Notices smells, sounds, sights, tastes, and the way things feel; remembers these sensations and believes that they are important parts of life; is sensitive to many forms of experience; may maintain an essentially hedonistic or aesthetic view of life." Each of these scales contains 16 items and a score is obtained by adding up the correct number of responses for each scale.

Jackson(1974) presents reliability data for psychiatric (N=83) and college(N=84) samples. He reports the following test-retest reliability coefficients for each scale for the psychiatric and college samples, respectively: Cognitive Structure: .29, .69; Impulsivity: .77, .85; Sentience, .69, .70. Mean scores for both the college student and psychiatric samples on all three scales are not significantly different.

Differential Personality Questionnaire(DPQ). The Differential Personality Questionnaire(Tellegen & Atkinson, 1974) is a 60 item True-False questionnaire designed to assess "hypnotic-like" experiences which might occur in everyday life and any attitudes which might be considered as related to hypnotizability. Tellegen and Atkinson describe Absorption as involving "a full commitment of available perceptual, motoric, imaginative, and ideational resources to a unified representation of the attentional object."(p. 274) Furthermore, they view the following three phenomena as logical correlates of Absorption: 1)a heightened sense of the reality of the attentional object-the attentional object is real even if only present in memory, 2)an imperviousness to normally distracting events-the individual high in absorption may not notice events that normally are distracting, and 3)an altered sense of reality in general and of self, in particular-attention is highly focused which causes the perception of some events to be amplified while other events move to the background.

One group of subjects(N=142) completed the Q3 questionnaire(60 of the scale's 71 items were the DPQ) in addition to 2 scales related to hypnotic depth and hypnotic susceptibility. A second group(N=171) also completed the Q3 along with the Group Scale of Hypnotic Susceptibility-Form A. Alpha reliability coefficients ranging from .48 to .74 were computed for Sample 1 and from .53 to .80 for Sample 2. A factor analysis of the Q3 questionnaire produced 3 higher order factors: Stability, Introversion, and Absorption.

These 3 factors were tested to determine the extent of their relationship to hypnotic susceptibility and hypnotizability. None of the 3 factors, except Absorption, exhibited any relationship to hypnotizability. Within Sample 1, Absorption significantly correlated with hypnotic susceptibility($r=.27$) and hypnotic depth($r=.42$). In Sample 2, Absorption was significantly correlated with hypnotic susceptibility($r=.43$). Stability and Introversion both exhibited low non-significant positive and negative correlations with hypnotic depth and hypnotic susceptibility.

Pre-Post Measures

Cognitive-Somatic Test of Anxiety. The Cognitive-Somatic Test of Anxiety(Holmes, Note 1) is a test which assesses three separate subjective components of the relaxation process: cognitive anxiety, somatic anxiety, and level of relaxation. This test consists of 21 items, each of which is answered on a 1 to 5 scale. A rating of 1 indicates that the subject was not experiencing the feeling at all while a rating of 5 indicates that the person was experiencing the particular feeling very much. Each of these scales(cognitive anxiety, somatic anxiety, and level of relaxation) is composed of seven items with possible scores for each subscale ranging from 7 to 35. High scores on cognitive anxiety and/or somatic anxiety indicate that the person was experiencing high levels of these types of anxiety while a high score on relaxation demonstrates that the subject felt a high level of relaxation at that time.

Cognitive Appraisal Rating Scale(CARS). The Cognitive Appraisal Rating Scale(Tetkoski, Note 3), an unvalidated measure, was designed to assess an individual's appraisal of his/her performance on a task and expectancies regarding future performance. This instrument consists of 10 items which are rated on a scale of 1 to 7. A rating of 1 indicates some negative appraisal of or strong disagreement with that item, a rating of 4 indicates either average or neutral appraisal, and a rating of 7 indicates strong agreement with or positive appraisal of the situation. For the purposes of the current study, one item, "I could have performed better if the experimenter wasn't in the room with me", was omitted since it did not pertain to the treatment situation. Possible scores, with this item omitted, range from 9 to 63 with 9 indicating a low or negative appraisal of performance and 63 indicating a high or positive appraisal of performance. In the one study utilizing the CARS(Tetkoski, 1980), no difference was found between depressed and nondepressed subjects in the cognitive appraisal of their performance.

Activation-Deactivation Adjective Check List-Short Form(ADACL). The Activation-Deactivation Adjective Check List(Thayer, 1967) was developed as an objective self-report measure of transient levels of physiological activtion. This scale consists of four factors(general activation, deactivation-sleep, high activation, and general deactivation) that are related to different levels of physiological arousal.

The ADACL-Short Form consists of 20 items(five items per factor) which are rated on a 4 point scale. These ratings indicate whether the subject: 1)definitely does feel, 2)feels slightly, 3)cannot decide, or 4)definitely does not feel the stated sensation. On each factor, scores range from 4 to 20. High scores indicate high levels of agreement with the items describing the factor while low scores show little agreement with the factor description. General activation is described by adjectives such as full-of-pep, active, vigorous, energetic, and lively while the deactivation-sleep factor includes the adjectives, drowsy, sleepy, tired, wide-awake, and wakeful. Likewise, the high activation factor is described by tense, jittery, clutched-up, intense, and fearful and the general deactivation adjectives include placid, at-rest, calm, still, and quiet.

Thayer(1978) reported the following test-retest reliability coefficients for his standardization sample(N=101, 59 males, 42 females): General Activation, .89; High Activation, .93; General Deactivation, .79; and Deactivation-Sleep, .89. Reliability coefficients calculated for males and females were almost exactly the same for both General Activation and Deactivation-Sleep. For the High Activation factor, reliability for females was .86 while the reliability coefficient for males was .87. For General Deactivation, females had a reliability coefficient of .85 and males had a reliability of .66. In a second study attempting to establish reliability, 486 males and females were administered the ADACL-Short Form. Average reliability coefficients for the four factors were as follows: High Activation, .62; General Activation, .71; Deactivation-Sleep, .61; and General Deactivation, .68. When the Spearman-Brown formula was employed to estimate the factor reliabilities of the full-length test, the following results were obtained: General Activation, .92; High Activation, .89; General Deactivation, .89; and Deactivation-Sleep, .91.

Apparatus

To detect frontalis muscle activity, three silver/silver chloride electrodes were placed on the subject's forehead as suggested by Lippold(1967). The EMG signal was processed for measurement and feedback purposes by a J & J M-55 Electromyograph feedback unit. This battery operated unit, which was in the experimental room with the subject, was set to produce auditory feedback in the form of a pulsating tone that became higher and faster when muscle activity increased and lower and slower as it decreased. The data were recorded by a J & J M-150 Digital Integrating Scorekeeper which averaged the EMG signal over one minute intervals and converted the raw EMG signal in a digital display. This piece of equipment, along with a tape recorder which was used to administer instructions to the subjects, was located in a room adjacent to the experimental room in which the experimenters monitored and recorded all readings. The experimental room contained a reclining chair, headphones, a table, and a small supply cart on which sat the actual EMG unit and loudspeaker for the auditory feedback.

Procedure

Prior to the relaxation training sessions all subjects had participated in a blanket survey of the introductory psychology classes in which they were asked to fill out(among others) the following measures: Differential Personality Questionnaire(Tellegen & Atkinson, 1974), Generalized Expectancy of Success Scale(Fibel & Hale, 1978), Rotter's Internal-External Control Scale(Rotter, 1966), three scales(Impulsivity, Cognitive Structure, and Sentience) of the Personality Research Form-Form E(Jackson, 1974), and Psychological Differentiation Inventory(Evans, 1969). All subjects then attended a separate small group testing session to complete the following measures: Verbalizer-Visualizer Questionnaire(Richardson, 1977), Breskin's Test of Non-Verbal Rigidity(Breskin, 1968), Sheehan's(1967a) adaptation of Betts'(1909) Questionnaire Upon Mental Imagery, the Autonomic Perception Questionnaire(Borkovec, 1976a), and the Remote Associates Test(Mednick & Mednick, 1967).

After completing these questionnaires, the subjects signed up for and attended two individual relaxation training sessions which were held no more than one week apart. Subjects were randomly assigned to conditions by the project's author prior to coming to the laboratory for the initial training session.

Upon arriving at the laboratory for the first relaxation training session, the subject was asked to sign a Consent Form(see Appendix A) which gave a brief description of the study. While sitting in the recording area of the laboratory, he/she was then given a brief explanation of the EMG apparatus and the scorekeeper. The experimenter then answered any questions that the subject may have had and escorted the subject into the experimental room where he/she was instructed to sit back in the reclining chair. The experimenter then asked the subject to put on the headphones and listen to the instructions which were presented over the tape(see Appendix B). Subjects were told that the purpose of the study was to investigate how people relax and the strategies that they employ to relax themselves. The subjects were also informed that their progress in relaxing would be monitored throughout the two sessions via electrodes which would be placed on their foreheads. They were asked to devote their full attention to relaxing and, to screen out external noises, were also asked to wear headphones throughout the two relaxation sessions.

At the completion of the this initial taped introduction to the procedure, the tape was stopped. The experimenter reentered the experimental room and applied the electrodes to the subject's forehead. During the electrode application, the following explanation was given to the subject:

> "These three electrodes, as was previously stated on the tape, will pick up the electrical activity in your forehead muscles. To help the electrodes pick up this activity, gel is placed in each electrode which is then placed on your forehead with an adhesive disc."

Once the electrodes had been applied to the subject's forehead, and all the subject's questions had been answered, the experimenter checked the electrodes' contact with the subject's skin. The experimenter then instructed the subject to lean back in the chair(and helped them do this, if necessary), close his/her eyes, and relax as much as possible for twelve minutes. This was their time to become accustomed to the electrodes and the surroundings. The experimenter allowed twelve minutes for the subject to adapt to the situation during which readings were taken on the subject's EMG level every minute for the entire twelve minutes.

The experimenter reentered the room at the end of the twelve minutes and administered the Cognitive-Somatic Test of Anxiety(Holmes, Note 1) and the Activation-Deactivation Adjective Check List(Thayer, 1967) with the instructions that the subject answer the questions as he/she felt at that time. After the completion of the questionnaires, the experimenter instructed the subject to again lean back in the chair and listen for further instructions through the headphones.

These taped instructions began by introducing the fifteen minute relaxation period. All subjects were instructed to relax their muscles in their bodies as deeply as possible during this fifteen minute period. The specific instructions and conditions of this period, given on tape, varied according to the experimental group to which the subject was assigned.

Biofeedback Condition. Subjects in this condition were informed via tape(see Appendix C) that they would be given biofeedback to aid their relaxation. No specific instructions were given concerning possible relaxation strategies. They were, however, told that the auditory feedback would reflect the tension level in the frontalis muscles of their forehead by becoming higher and faster when muscle tension increased and by becoming lower and slower when the tension level decreased. The experimenter demonstrated this to the subject by having him/her tighten and relax the muscles in the jaw and noting the difference in the tones. The experimenter then adjusted the tone volume to a comfortable level for the subject. Subjects were told that the information from the auditory tone may be useful to them in developing effective relaxation strategies. All subjects in this condition received continuous auditory feedback over the headphones throughout the entire fifteen minute relaxation training period.

No-Biofeedback Condition. Subjects in this condition were given instructions via tape(see Appendix D) to relax as deeply as possible but were not given any information about biofeedback. They were told that, in general, people can develop their own effective relaxation strategies if given the opportunity. No mention of alternate possible relaxation techniques was made. They were then given a fifteen minute period to practice relaxation during which they also wore headphones to screen out external noises. During this time, the headphones were not plugged in so that the subject did not receive feedback of any kind.

During the fifteen minute relaxation training period, the experimenter was in an adjacent room and recorded the subject's average EMG level for the fifteen one-minute intervals of the relaxation period. When the fifteen minutes had elapsed, the experimenter reentered the room to administer the Cognitive-Somatic Test of Anxiety, the ADACL, and the Cognitive Appraisal Rating Scale(Tetkoski, Note 3). The subjects were then unhooked from the electrodes and the next appointment was confirmed.

Session 2 was conducted within two to four days of the first session. All subjects, both biofeedback and no-biofeedback conditions, were escorted into the experimental room and were seated in the reclining chair where they were hooked up with the electrodes. The experimenter then informed the subject that he/she had twelve minutes to become accustomed to the situation, as had been the case in Session 1. The experimenter monitored the subject's EMG level every minute for the duration of this twelve minute period. At the end of this adaptation period, the experimenter asked the subject to fill out the Cognitive-Somatic Test of Anxiety and the ADACL. Subjects in the biofeedback condition were given the following instructions via tape:

> "We will now begin the relaxation training part of this laboratory session. As in the prior session, you will be asked to relax and will be aided in this by biofeedback. Remember, when your muscles become tense, the tone gets higher and faster; when they relax, the tone becomes lower and slower. Therefore, you will be attempting to keep the tone as low and as slow as you can throughout the duration of this training session. We would like you to sit back, close your eyes, and relax your muscles as deeply as you can, but do not fall asleep during this time. You may now begin to relax."

Subjects in the no-biofeedback condition were given the following instructions via tape:

> "We will now begin the relaxation training part of this laboratory session. You will again be given fifteen minutes during which to practice relaxation. We will not be giving you any specific strategies as to how to relax. You are to use any strategies that help you relax as much as possible in the time provided. We would like

you to sit back, close your eyes, and relax your muscles as deeply as you can, but do not fall asleep during this time. You may now begin to relax."

The experimenter then recorded the subject's average EMG level at one-minute intervals throughout the fifteen minute relaxation training period. At the end of the training period, the experimenter asked the subject to fill out the Cognitive-Somatic Test of Anxiety, the ADACL, the CARS, a semantic differential that focused on experimenter characteristics, and a questionnaire directed at determining relaxation strategies employed by the subject during both relaxation periods. The subject was then unhooked from the electrodes, thanked for his/her participation, and allowed to leave.

CHAPTER IV

RESULTS

Data Reduction and Preliminary Analyses

Each subject had EMG muscle tension level measurements taken twelve times during each of the two Adaptation periods and fifteen times during each of the two Training periods. For the purposes of the data analysis, means were calculated for the last two trials of each Adaptation period and for each set of three trials in both Training periods. These calculations yielded twelve pieces of data which were employed in subsequent analyses.

A 2(Sex) x 2(Treatment Modality) x 2(Session) repeated measures analysis of variance was performed on the Adaptation period EMG data in order to determine whether EMG level during Adaptation period differed according to either the sex of the subject or the treatment group to which subjects were assigned (see Table 1). This analysis yielded significant main effects for both sex of the subject, $F(1,76)=10.79, p<.01$, and session, $F(1,76)=4.98$, $p<.03$. Males ($M=2.10$) had lower EMG readings during the Adaptation periods than females ($M=2.74$). In addition, EMG readings during the Adaptation period, Session 1 ($M=2.52$) were significantly higher than those obtained in the Adaptation period, Session 2($M=2.32$). These results supported the hypothesis that there would be a significant reduction in EMG muscle tension levels from the Adaptation period in Session 1 to the Adaptation period in Session 2. There was neither a significant main effect for treatment modality nor were there any significant interactions from the analysis.

Sex Differences and Biofeedback Response

Several hypotheses were advanced concerning subjects' responses to the biofeedback treatment situation. They focused on the effects of sex of subject and treatment group on ability to successfully employ the relaxation treatment and whether or not there would be a generalized reduction in EMG muscle tension level across various predetermined points in the treatment regimen. One of the three hypotheses concerned with intrasubject differences(e.g., EMG change from Adaptation period 1 to Adaptation period 2) was addressed in the preliminary data analysis section which, as previously noted, yielded a significant difference in EMG level from Adaptation period 1 to Adaptation period 2.

Other hypotheses concerned with sex, treatment, and intrasubject differences were examined in the context of a 2(Sex) x 2(Treatment Modality) x 10(Trials) repeated measures analysis of variance, employing sex and treatment modality as grouping factors. This analysis yielded a significant main effect for treatment modality, $F(1,76)=3.96, p<.05$, which indicated that subjects receiving biofeedback treatment($M=1.91$) had significantly lower EMG levels during training than subjects receiving only instructions to relax($M=2.22$). These results support the hypothesis that biofeedback training would aid muscle tension reduction.

TABLE 1

Repeated Measures ANOVA on Adaptation Period Data

Source	SS	DF	MS	F
SEX(S)	16.55	1	16.55	10.79 **
BIO(B)	.46	1	.46	.30
S x B	0.00	1	0.00	0.00
ERROR	116.57	76	1.53	
TRIAL(T)	1.56	1	1.56	4.98 *
T x S	.15	1	.15	.47
T x B	0.00	1	0.00	0.00
T x S x B	.04	1	.04	.11
ERROR	23.87	76	.31	

*$p<.03$
**$p<.002$

A significant main effect was also found for the sex variable, $F(1,76)=7.03, p<.01$, with males(M=1.86) exhibiting significantly lower overall EMG muscle tension levels than females(M=2.27), regardless of treatment grouping assignment. The sex by treatment modality interaction, however, was not significant. There was thus no support for the hypothesis that female subjects in the biofeedback condition are better able to reduce EMG muscle tension than females in the no-biofeedback condition (see Table 2).

This analysis also yielded a significant main effect for trials, $F(11,833)=11.13, p<.01$, which indicated that the EMG muscle tension level for all subjects decreased throughout the duration of the treatment. To further explore this general decrease in EMG level across trials and to test specific hypotheses in this regard, two additional planned comparisons were performed within the context of this ANOVA. First, EMG levels from the first Adaptation period were compared to the mean EMG levels for the final Training period(i.e., average EMG level for the entire 15 minute period). This planned comparison yielded a significant difference, $F(1,833)=44.54, p<.001$, and thus supported the hypothesis that there would be a significant reduction in EMG muscle tension level from Adaptation period in Session 1 to the Training period in Session 2. Second, mean EMG levels from the first Training period were compared to mean EMG levels from the second Training period. This planned comparison yielded no significant reduction, $F(1,833)=.85, p$=N.S., in EMG level from the first 15 minute Training period(M=2.03) to the second Training

TABLE 2

Repeated Measures ANOVA on all Modified EMG Data

Source	SS	DF	MS	F
SEX(S)	40.06	1	40.06	7.03 **
BIO(B)	22.58	1	22.58	3.96 *
S x B	0.00	1	0.00	0.00
ERROR	433.18	76	5.70	
TRIAL(T)	35.70	11	3.25	11.13 **
COMP. 1	7.91	1	7.91	27.18 ***
COMP. 2	.25	1	.25	.85
COMP. 3	12.96	1	12.96	44.54 ***
T x S	4.87	11	.44	1.52
T x B	6.43	11	.58	2.00
T x S x B	1.10	11	.10	.34
ERROR	243.77	833	.29	

*$p<.05$
**$p<.01$
***$p<.001$

Note: COMP. 1= Planned comparison from Adaptation 1 to Adaptation 2
COMP. 2= Planned comparison from Training 1 to Training 2
COMP. 3= Planned Comparison from Adaptation 1 to Training 2

period($\underline{M}$=1.95). Therefore, the hypothesis dealing with EMG level change from the first Training period to the second one was not supported. Table 3 presents the means of all the EMG data for both Session 1 and 2 across all four subject groups.

In light of the preliminary finding that there was a significant difference in the Adaptation periods due to the sex of the subject and across sessions, a 2(Sex) x 2(Treatment Modality) x 2(Sessions) x 5(Trials) analysis of covariance was performed with the Adaptation period 1 score employed as the covariate. As in the ANOVA, a significant main effect for treatment modality was found, $\underline{F}(1,75)=6.62, \underline{p}<.05$, with biofeedback subjects ($\underline{M}$=1.84) having significantly lower EMG muscle tension levels than the no-biofeedback subjects($\underline{M}$=2.14). There was neither a significant main effect for sex nor a significant sex x treatment interaction. A marginal treatment x session interaction, $\underline{F}(1,75)=3.27, \underline{p}=.074$, was found with subjects in the biofeedback group demonstrating a decrease in EMG muscle tension level from Session 1($\underline{M}$=1.93) to Session 2($\underline{M}$=1.74) while the subjects in the no-biofeedback group showed a slight non-significant increase in EMG level from Session 1 ($\underline{M}$=2.13) to Session 2($\underline{M}$=2.16) (see Table 4).

In summary, these results from both the ANOVA and ANCOVA indicated that subjects receiving biofeedback treatment exhibited lower EMG levels than subjects in the no-biofeedback group. The results also indicated that there was no evidence of sex differences in response to biofeedback treatment.

TABLE 3

Means for all EMG Data

	MALE		FEMALE	
	BIO	NO-BIO	BIO	NO-BIO
SESSION 1				
ADAPTATION	2.11	2.23	2.84	2.91
TRAINING 1	1.85	2.15	2.20	2.59
2	1.74	2.12	2.13	2.42
3	1.68	1.94	2.20	2.27
4	1.65	1.70	2.10	2.23
5	1.58	1.79	2.00	2.26
SESSION 2				
ADAPTATION	1.99	2.07	2.54	2.69
TRAINING 1	1.73	2.23	1.93	2.43
2	1.54	2.26	1.89	2.37
3	1.55	2.07	1.86	2.33
4	1.56	1.94	1.85	2.26
5	1.48	1.64	1.84	2.29

TABLE 4

ANCOVA on EMG Data

Source	SS	DF	MS	F
COV.	151.83	1	151.83	54.10
SEX(S)	.67	1	.67	.24
BIO(B)	18.59	1	18.59	6.62 *
S x B	.02	1	.02	.01
ERROR	210.49	75	2.81	
SESSION(R)	1.24	1	1.24	1.63
R x S	.71	1	.71	.92
R x B	2.52	1	2.52	3.29
R x S x B	0.00	1	0.00	0.00
ERROR	58.13	76	.76	
TRIAL(T)	7.92	4	1.98	7.51 ***
T X S	.94	4	.24	.47
T x B	1.52	4	.38	.22
T x S x B	.79	4	.19	.56
ERROR	80.18	304	.26	
R x T	.21	4	.05	.44
R x T x S	.43	4	.11	.91
R x T x B	.27	4	.07	.58
R x T x S x B	.48	4	.12	1.02
Error	35.89	304	.12	

*$p<.05$, ***$p<.001$

NOTE: First Adaptation period was employed as the covariate.

Analysis of Personality Questionnaire Data

A number of personality measures were administered to all subjects prior to their participation in the relaxation training phase of the study. Table 5 reports the intercorrelation matrix among the means the personality measures. Among the strongest correlations obtained were cognitive structure with impulsivity($r=-.65$), sentience with level of absorption($r=.53$), sentience with cognitive flexibility($r=.45$), sentience with vividness of mental imagery($r=-.45$), and vividness of mental imagery with level of absorption($r=.41$).

Once it had been established that there was some degree of relationship between a number of these personality variables, a factor analysis was performed on the matrix. The purpose of this analysis was to determine which of the personality variables could be grouped together in subsequent multiple regression analyses. This factor analysis produced four orthogonal factors which accounted for 67% of the cumulative variance. The first factor, called Inner Directed Attention, which accounted for 22.6% of the variance, contained four of the personality variables: sentience, absorption level as measured by the DPQ, vividness of mental imagery, and cognitive flexibility as measured by the RAT. These four personality variables correlated .810, -.737, .730, and .516, respectively, with Factor 1.

A second factor extracted from the factor analysis accounted for 21.2% of the cumulative variance explained by all the factors and also consisted of four personality variables. This factor, called Cognitive

TABLE 5

Pearson Product-moment Correlation Matrix

	BRT	VVQ	VMI	APQ	RAT	COG	IMP	SEN	F-D	GES	DPQ	LOC
BRT	1.00											
VVQ	.07	1.00										
VMI	.09	-.09	1.00									
APQ	-.08	.04	-.01	1.00								
RAT	-.27**	-.11	-.20*	.09	1.00							
COG	-.06	-.26**	.00	.02	-.06	1.00						
IMP	.05	.32	-.04	.08	.09	-.65**	1.00					
SEN	-.17	.01	-.46**	.07	.45**	-.08	.05	1.00				
F-D	.22*	-.05	.07	-.20*	-.24*	-.15	.14	-.27**	1.00			
GES	.02	.15	-.17	-.08	-.08	.04	-.16	-.04	-.13	1.00		
DPQ	-.26**	-.06	-.41**	.18	.16	-.09	-.09	.53**	-.15	.10	1.00	
LOC	.10	.30	.15	.03	-.22*	-.21*	.34**	-.13	.15	-.08	-.16	1.00

* $p < .05$
** $p < .01$

Control, contained impulsivity, cognitive structure, locus of control, and verbalizer-visualizer which had correlations of .866, -.783, .580, and .573 with the factor. The third factor, called External Orientation, accounted for 14.1% of the variance and contained three personality variables: field dependence, level of autonomic perception as measured by the APQ, and non-verbal rigidity as indicated by the BRT. These variables correlated .725, -.686, and .451, respectively, with Factor 3. Finally, the fourth factor produced by the analysis contained only one measure, expectancy of success, which correlated .799 with the factor and accounted for 12.8% of the total variance(see Table 6).

Cognitive Style and Biofeedback Response

A number of hypotheses were advanced concerning the relationship between various cognitive styles and individuals' responses to biofeedback treatment. These hypotheses were addressed through 3 pairs of stepwise multiple regression analyses. One pair of analyses addressed the total EMG training effect which was calculated by taking the difference between EMG level for Adaptation period, Session 1, and Training period, Session 2. The second pair of multiple regression analyses examined the 'day effect' which was computed by taking the difference between the sums of the Adaptation and Training periods for Session 1 and the Adaptation and Training periods for Session 2. In this way, it was possible to obtain an index of the training effect in Session 1 as compared to that effect in Session 2. The third pair of multiple regression analyses examined the 'within session' training effect. This

TABLE 6

Factor Analysis-Varimax Rotated/Sorted Factor Loadings

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Communality
SEN	.810	.067	-.184	-.098	.7042
VMI	-.737	.026	-.119	-.282	.6369
DPQ	.730	-.031	-.142	.075	.5599
RAT	.516	-.093	-.302	-.367	.5006
IMP	.006	.866	.041	-.134	.7703
COG	-.195	-.783	-.164	.116	.6910
LOC	-.322	.580	-.044	.111	.4538
VVQ	-.033	.573	-.148	.538	.6407
F-D	-.163	.174	.725	-.206	.6249
APQ	-.034	.129	-.686	-.062	.4925
GES	.116	-.155	.039	.799	.6779
BRT	-.276	.104	.451	.190	.3266
EIGEN VALUES	2.259	2.124	1.413	1.283	
NAME	Inner Directed Attention	Cognitive Control	External Orientation	Expectancy of Success	

was obtained by taking the difference between the Adaptation and Training periods in Session 1 and adding it to the difference between Adaptation and Training periods in Session 2.

In all three pairs of multiple regression analyses, the dependent variable was an EMG value which was specified by the particular effect of interest(e.g., total training effect, day effect, or within session effect). In the first multiple regression in each of the three pairs, all the personality variables, as derived from the questionnaire data, were employed as predictors. The second multiple regression analysis in each of the three pairs employed only the four factors that emerged from the factor analysis of the personality variables as potential predictor variables.

The multiple regression analyses for the total training effect did not yield any significant predictors, either individual variables or factors, in regression equations. Likewise, neither the second pair of multiple regression analyses for the day effect nor the pair of multiple regression analyses for the within session effect produced regression equations containing any significant predictor variables. Bivariate correlations, calculated between each individual predictor and the three individual dependent variables, indicated that there was little relationship between the prospective predictors and the dependent variables(see Table 7). On the basis of these results, none of the null hypotheses relating cognitive style to biofeedback could be rejected.

TABLE 7

Correlations of Predictor Variables and Dependent Variables

VARIABLE	SESSION EFFECT	DAY EFFECT	TOTAL TRAINING EFFECT
GEN 1	.118	.131	.153
GEN 2	.196	.051	.167
BIO	-.114	-.099	-.133
BRT	-.022	.133	.054
VVQ	.035	.181	.120
VMI	-.075	-.021	-.065
APQ	.136	.172	.188
RAT	.038	.069	.063
COG	.030	-.097	-.030
IMP	.056	.085	.085
SEN	-.126	-.032	-.107
F-D	.027	.031	.036
GES	-.056	-.045	-.064
DPQ	-.024	-.048	-.043
LOC	.199	.054	.170
EMG 1	.538	.397	.594
EMG 2	-.273	.174	-.104
EMG 3	.381	-.203	.166
EMG 4	-.302	-.319	-.384
FAC 1	-.068	-.033	-.066
FAC 2	.052	.158	.121
FAC 3	-.087	-.066	-.097
FAC 4	.006	.024	.017

Note: Correlations must exceed .184 to be significant at the .05 level.

Self-Reported Anxiety and Relaxation Data

A group of hypotheses was advanced to address changes in levels of anxiety and amount of relaxation across the course of training. Table 8 reports the means of the cognitive anxiety, somatic anxiety, and relaxation subscales for each of the three measurement points. Analyses of covariance were performed on all the scales comprising both the Cognitive-Somatic Test of Anxiety(Cognitive Anxiety, Somatic Anxiety, and Relaxation) and the ADACL(General Activation, High Activation, Deactivation-Sleep, and General Deactivation) with the first measurement on each scale being used as the covariate for all subsequent measurements. The ANCOVA on the Cognitive Anxiety scale yielded neither significant main effects nor significant interactions (see Table 9). Of interest in this analysis, as with all succeeding analyses, was the trials main effect which did not approach significance (F=.84) and which did not support the hypothesis that all subjects would demomstrate a decrease in cognitive anxiety across sessions.

The ANCOVA for the Somatic Anxiety scale did not show a significant trials main effect, $F(2,152)=2.09, p=.12$, and did not support the hypothesis that all subjects would demonstrate a significant decrease in somatic anxiety across sessions (see Table 10). However, there was a significant main effect, $F(1,75)=7.06$, $p<.01$, on the modality variable which indicated that subjects not receiving biofeedback had significantly lower somatic anxiety scores (M=9.32) than subjects receiving biofeedback treatment (M=10.62). It appears that the biofeedback

TABLE 8

Adjusted Cell Means for Cognitive-Somatic Test of Anxiety

		MALE		FEMALE	
SUBSCALE	TRIAL	BIO	NO-BIO	BIO	NO-BIO
COGNITIVE	COV.	7.65	7.80	8.40	8.15
ANXIETY	1	8.09	7.08	8.24	7.09
	2	7.34	7.43	6.89	7.64
	3	8.19	6.88	6.69	6.94
SOMATIC	COV.	11.20	10.25	11.20	11.10
ANXIETY	1	11.44	9.38	11.74	9.23
	2	10.24	9.83	9.64	8.98
	3	10.99	9.63	9.64	8.88
RELAXATION	COV.	31.20	29.00	31.00	28.00
	1	29.60	32.36	29.68	33.35
	2	30.85	30.61	31.63	30.65
	3	30.00	32.31	32.63	32.90

TABLE 9

Analysis of Covariance on Cognitive Anxiety Data

SOURCE	SS	DF	MS	F
1st COV.	326.87	1	326.87	40.15
SEX(S)	3.83	1	3.83	.47
BIO(B)	9.44	1	9.44	1.16
S x B	7.21	1	7.21	.89
ERROR	610.63	75	8.41	
TRIAL(T)	8.40	2	4.20	.84
T x S	6.93	2	3.47	.69
T x B	23.03	2	11.52	2.29
T x S x B	7.23	2	3.62	.72
ERROR	764.40	152	5.03	

treatment, while producing lower EMG muscle tension levels, did not lead to a similar subjective experience of lower somatic anxiety. Finally, the ANCOVA for the Relaxation scale produced no significant main effects, either for sex, modality, or trials and did not support the hypothesis that subjects would exhibit an increase in the level of relaxation across sessions(see Table 11).

As previously mentioned, analyses of covariance were performed on all four subscales of the ADACL. Table 12 reports the means for each of the subscales at each of the measurement points. The results from the ANCOVA on the General Deactivation scale indicate a significant trial x modality interaction, $\underline{F}(2,152)=7.04, \underline{p}<.002$ (see Table 13). Subjects who received biofeedback showed an increase in the level of general deactivation from the second to the third measurement(first measurement is the covariate) but then demonstrate a decrease in the level of general deactivation on the last measurement. Subjects not receiving biofeedback, on the other hand, have a different pattern of results. They exhibit a decrease in level of general deactivation from the second to the third measurement which is then followed by an increase at the fourth (and last) measurement. However, for the hypothesis concerning a general increase in level of general deactivation across trials, no significant main effect for trials was found.

The ANCOVAs both for the High Activation (see Table 14) and for the Deactivation-Sleep (see Table 15) scales yielded neither significant main effects for trials nor any significant effects for sex or treatment

TABLE 10

Analysis of Covariance on Somatic Anxiety Data

SOURCE	SS	DF	MS	F
1st Cov.	342.96	1	342.96	24.42
SEX(S)	19.22	1	19.22	1.37
BIO(B)	99.20	1	99.20	7.06 **
S x B	.02	1	.02	.00
ERROR	1053.29	75	14.04	
TRIAL(T)	28.06	2	14.03	2.09
T x S	13.41	2	6.71	1.00
T x B	32.26	2	16.13	2.40
T x S x M	3.11	2	1.55	.23
ERROR	1020.50	152	6.71	

$^{**}p<.01$

TABLE 11

Analysis of Covariance on Relaxation Level Data

SOURCE	SS	DF	MS	F
1st Cov.	1115.55	1	1115.55	18.71
SEX(S)	43.35	1	43.35	.73
BIO(B)	96.02	1	96.02	1.61
S x B	5.77	1	5.77	.10
ERROR	4471.15	75	59.62	
TRIAL(T)	44.16	2	22.08	.87
T x S	17.41	2	8.70	.34
T x B	146.31	2	73.15	2.87
T x S x B	21.86	2	10.93	
ERROR	3869.60	152	25.46	

TABLE 12

Adjusted Cell Means for Subscales of the ADACL

		MALE		FEMALE	
SUBSCALE	TRIAL	BIO	NO-BIO	BIO	NO-BIO
HIGH	COV.	7.70	6.85	7.40	8.55
ACTIVATION	1	8.21	6.42	7.06	6.56
	2	7.21	7.32	7.41	6.46
	3	7.71	7.43	6.86	6.16
GENERAL	COV.	16.00	16.60	15.60	15.40
DEACTIVATION	1	15.36	17.29	14.48	16.67
	2	15.66	15.09	15.58	14.47
	3	14.46	15.69	14.98	15.77
DEACTIVATION	COV.	11.35	10.95	10.50	12.30
SLEEP	1	12.66	12.38	10.62	10.84
	2	10.81	11.23	12.57	8.64
	3	10.41	11.68	11.57	10.24
GENERAL	COV.	9.15	8.95	9.60	8.90
ACTIVATION	1	8.15	8.72	10.48	8.20
	2	10.50	9.02	9.93	10.25
	3	11.65	9.27	9.33	8.95

TABLE 13

ANCOVA on General Deactivation Data

SOURCE	SS	DF	MS	F
1st COV.	216.54	1	216.54	15.07
SEX(S)	3.18	1	3.18	.22
BIO(B)	30.41	1	30.41	2.12
S x B	1.50	1	1.50	.10
ERROR	1077.83	75	14.37	
TRIAL(T)	33.10	2	16.55	2.87
T x S	9.43	2	4.72	.82
T x B	81.10	2	40.55	7.04 ***
T x S x B	1.03	2	.52	.09
ERROR	875.33	152	5.76	

***$p < .002$

modality. These results fail to support the respective hypotheses for the these two scales. The General Activation scale yielded both a significant main effect for trials, $F(2,152)=3.65, p<.03$, and a significant trials x sex interaction, $F(2,152)=3.79, p<.03$ (see Table 16). The main effect for trials appears to indicate that there is an increase in the level of general activation across trials which is contrary to, and fails to support, the hypothesis that all subjects would exhibit a decrease in level of general activation across time. With regard to the significant sex by trials interaction, a Newman-Keuls post hoc analysis demonstrated that males exhibited a significant increase in their level of general activation across all trials. While females appeared initially to increase and later to decrease their level of general activation, a Newman-Keuls post hoc analysis indicated that there were no significant differences in level of general activation across all trials.

A repeated measures ANOVA was performed on the data from the Cognitive Appraisal Rating Scale and no significant results were obtained(see Table 18). This indicated that there was no difference in the cognitive appraisal of their performance, as measured by the CARS, by subjects receiving and not receiving biofeedback. Furthermore, the results of this analysis did not support the hypothesis that there would be a significant change in cognitive appraisal of performance from Session 1 to Session 2.

TABLE 14

ANCOVA on High Activation Data

SOURCE	SS	DF	MS	F
1st COV.	438.74	1	438.74	41.35
SEX(S)	23.53	1	23.53	2.22
BIO(B)	28.35	1	28.35	2.67
S x B	.03	1	.03	.00
ERROR	795.83	75	10.61	
TRIAL(T)	.16	2	.08	.02
T x S	5.73	2	2.86	.73
T x B	6.36	2	3.18	.81
T x S x B	14.73	2	7.36	1.87
ERROR	597.03	152	3.93	

TABLE 15

ANCOVA on Deactivation-Sleep Data

SOURCE	SS	DF	MS	F
1st COV.	1321.45	1	1321.45	46.77
SEX(S)	36.25	1	36.25	1.28
BIO(B)	21.87	1	21.87	.77
S x B	68.02	1	68.02	2.41
ERROR	2119.06	75	28.25	
TRIAL(T)	29.58	2	14.79	1.53
T x S	31.26	2	15.63	1.61
T x B	39.68	2	19.84	2.05
T x S x B	60.33	2	30.16	3.11
ERROR	1473.83	152	9.70	

TABLE 16

ANCOVA on General Activation Data

SOURCE	SS	DF	MS	F
1st COV.	1244.35	1	1244.35	51.76
SEX(S)	.05	1	.05	.00
BIO(B)	52.62	1	52.62	2.19
S x B	1.51	1	1.51	.06
ERROR	1803.20	75	24.04	
TRIAL(T)	51.33	2	25.66	3.65 *
T x S	53.36	2	26.68	3.79 *
T x B	6.61	2	3.30	.47
T x S x B	75.31	2	37.65	5.35
ERROR	1069.40	152	7.04	

*$p<.05$

TABLE 17

Repeated Measures ANOVA on CARS Data

SOURCE	SS	DF	MS	F
SEX(S)	9.51	1	9.51	.18
BIO(B)	.01	1	.01	.00
S x B	9.51	1	9.51	.18
ERROR	3993.43	76	52.55	
TRIAL(T)	2.26	1	2.26	.17
T x S	33.31	1	33.31	2.57
T x B	.16	1	.16	.01
T x S x B	43.06	1	43.06	3.32
ERROR	984.73	76	12.96	

Relaxation Strategies Data

At the completion of the second relaxation training session, each subject was asked to complete a questionnaire concerning relaxation strategies employed in both the first and second relaxation sessions. A 2(Sex) x 2(Treatment Modality) x 2(Trials) repeated measures ANOVA was performed on the rating for each relaxation strategy (ten in all) in the questionnaire. There was a significant session effect, $F(1,76)=7.06, p<.01$, in response to the statement, "Tried to let my mind wander by itself" such that subjects used this strategy more in the second training session than in the first training session. The statement, "Tried to intentionally have pleasant relaxing thoughts", while not yielding a session effect, did produce a significant main effect for sex, $F(1,76)=4.71, p<.04$. Females($M=3.76$) endorsed this item significantly more than males($M=3.08$) in this sample. Finally, a significant trial x sex interaction, $F(1,76)=4.22, p<.05$, was obtained in relation to the statement, "Focus on my breathing". A Newman-Keuls post hoc analysis indicated that male subjects did not significantly differ in their use of this strategy from Session 1 ($M=3.20$) to Session 2($M=3.07$) while the female subjects exhibited a significant increase in the use of this strategy across the two sessions($M=3.05$ to $M=3.68$). Furthermore, this analysis indicated that, while males and females did not differ in the use of this strategy in Session 1, females endorsed this strategy significantly more in Session 2 than did males. While the questionnaire listed seven other strategies in addition to the three listed here, none of them preduced either significant main effects or interactions. For none of the relaxation strategies was there a difference between subjects given biofeedback and those not given biofeedback. These results thus fail to support the hypothesis that there would be a difference in relaxation strategies between subjects given biofeedback and subjects not given biofeedback.

CHAPTER V

DISCUSSION

The purpose of this study was twofold: 1)to determine whether sex of subject was an important variable in the prediction of successful biofeedback training, and 2) to examine which combination(s) of cognitive style variables could be utilized to predict successful biofeedback performance. Secondarily, this study examined the effect of both the biofeedback and control treatments on subjects' self-reports of anxiety and tension and the relaxation strategies that they employed.

Biofeedback and EMG Reduction

As expected, the results indicated that the subjects who received biofeedback with instructions to relax exhibited significantly lower EMG muscle tension levels than subjects who received only instructions to relax. The results of this study are in agreement, for the most part, with prior research in this area(Coursey, 1975; Kinsman, O'Banion, Robinson, & Staudenmayer, 1975; Haynes, Moseley, & McGowan, 1975; LeBoeuf, 1980b) which asserted that EMG biofeedback treatment is superior in effectiveness to other relaxation treatments at reducing EMG muscle tension level.

There appear to be two possible interpretations of the better performance of biofeedback subjects-one is that there is an actual learning effect as a result of the biofeedback training, the other is that the effect is motivational in origin. A common sense explanation of these results would focus on the belief that the biofeedback subjects, due to their constant active involvement in the training process via the auditory feedback, would have a relatively high level of involvement and motivation in the training situation. The control subjects(those receiving verbal instructions to relax), by virtue of their not receiving any biofeedback, are less involved in the relaxation process, are more easily bored, receive less reinforcement, less attention, and, therefore, are more likely to exhibit a lower motivation level than subjects receiving biofeedback. A treatment manipulation which compensated for these differences in treatments might eliminate the observed differences between the two treatments.

Alexander, White, and Wallace(1977) tested this assumption with both biofeedback and control subjects while maintaining their levels of motivation throughout the sessions. Their results indicated that there was no difference between EMG biofeedback and a control condition at aiding relaxation when(and if) the level of motivation is maintained relatively constant across conditions. The authors concluded that, if control subjects lose their motivation to perform, this may be one possible explanation for the differences observed between the control subjects and those receiving EMG biofeedback or, possibly, progressive relaxation.

Since it appears that subjects receiving EMG biofeedback were better able to reduce EMG muscle tension than subjects receiving instructions to relax, an attempt was made to isolate the point during treatment at which this differential effect occurred. As expected, the results indicated that the EMG readings from the adaptation period in Session 2 were significantly lower than the EMG readings from the Session 1 adaptation period. One possible explanation for these results is that the training that the subjects received(either biofeedback or instructions to relax) aided the relaxation process. Furthermore, reductions in EMG level that occurred in the training period of Session 1 were enduring enough to carry over to the adaptation period of Session 2. In light of the fact that the results did not indicate any differential effect related to the type of treatment received, it appears likely that, at least initially, the subjects respond uniformly to the request to relax rather than focus primarily on the type of treatment employed to achieve the relaxed state. It is also possible that, at this point in the relaxation training, both groups of subjects are equally interested in the novelty of the task and are demonstrating comparable motivation levels during the first training period and adaptation period(s). An alternate explanation of these results is that they may simply be the result of an adaptation effect taking place. With an adaptation effect that both the biofeedback and the no-biofeedback groups experience, this would account for the observation that both groups are able to decrease EMG muscle tension levels during this part of the treatment.

Contrary to expectations, the results further indicated that subjects, regardless of treatment condition, did not exhibit significant decreases in EMG level from the training period in Session 1 to the training period in Session 2. It appears, therefore, that the majority of the significant reduction in EMG levels occurs very early in the training and that later treatment did not significantly add to the initial reduction of EMG muscle tension level. It is possible that what was being perceived as a treatment effect in the initial training periods may also have been an "adaptation" effect and that subsequent training periods might give a more accurate indication of the extent and degree of relaxation that results from the relaxation training. A note of caution is warranted at this point since these conclusions are based solely on the data obtained from a two-session treatment situation. If the number of treatment sessions was increased, it may be possible to assess the training effect over a more prolonged treatment regimen and determine if, in fact, there are significant reductions in EMG muscle tension level above and beyond the effect seen after a single treatment session.

Additionally, the results indicated, as expected, that the EMG muscle tension levels in the training period of Session 2 were significantly lower than those obtained in the adaptation period of Session 1. This comparison demonstrated that there was an overall decrease in EMG muscle tension level across all the trials regardless of the treatment condition. This effect is, of course, the most obvious one in this context since it examined the decreases in EMG muscle tension level across all trials. Furthermore, the results from the two prior planned comparisons(Adaptation period, Session 1 to Adaptation period, Session 2 and Training period, Session 1 to Training period, Session 2) comprise the overall trials effect.

Sex Differences in EMG Reduction

Contrary to predictions, there was no evidence of sex differences in response to biofeedback. Females appeared to have higher EMG levels but there was no evidence of differential change over the two sessions. Not only did females perform no better than males on the relaxation task in general, but also there was no differential response to biofeedback for subjects of either sex. The results obtained in this study apparently are contrary to those obtained by Rupert, Baird, and Tetkoski(Note 2). In addition to noting that males were able to reduce EMG muscle tension level regardless of whether or not they were treated with biofeedback, they found that females who received biofeedback were more adept at learning to relax than females who received only instructions to relax. The results reported by O'Connell, Frerker, and Russ(1979) were also contrary to those found in the present study. They found that, on the whole, males performed better than females with biofeedback.

The sole study in the literature on effects of sex of subject on biofeedback performance that is consistent with results obtained in the present study was done by Malec, Sipprelle, and Behring(1976). They concluded that there were no sex differences with regard to ability to use biofeedback. The results from the present study seem to add fuel to the debate over sex of subject and biofeedback performance rather than providing unequivocal evidence that sex of subject is or is not an important variable for this type of research. There now appears to be equally convincing evidence for either side of the debate that sex of subject may or may not be a potent variable in biofeedback research. Since a definite conclusion cannot be reached either supporting or rejecting the importance of this variable, it should not, at least for the present, be ignored as an unimportant, useless variable.

Individual Differences and Biofeedback Response

A group of cognitive style variables were examined in this study as potential predictors of EMG biofeedback performance. Contrary to predictions, the results from the two sets of multiple regression analyses inidcated that none of the cognitive style variables(locus of control, cognitive flexibility-rigidity, field dependence-independence, vividness of mental imagery, verbalizer-visualizer, absorption capacity, impulsivity, cognitive structure, sentience, expectancy of success, and level of autonomic perception) were significantly related to ability to reduce EMG muscle tension level.

The results from the present study were contrary to both expectations and the prior research in this area. Although none of the previous research has attempted to assess the range of variables included here, other studies have examined cognitive style variables in isolation or, at most, in pairs. Previous research has demonstrated some relationship between response to biofeedback and locus of control(e.g., Reinking, Morgret, & Tamayo; Carlson, 1977), field dependence(e.g., Bourgeois, Levenson, & Wagner, 1980), absorption capacity(e.g., Qualls & Sheehan, 1979; Qualls & Sheehan, 1981a; Qualls & Sheehan, 1981b), expectancy of success(e.g., Bradley & McCanne, 1981), and ability to visually image(e.g., LeBoeuf & Wilson, 1978). In addition, reflection-impulsivity(e.g., Kagan, 1965; Klein, Blockovich, Buchalter, & Huyghe, 1976) and cognitive flexibility(e.g., Gorman & Breskin, 1969; Cosden, Ellis, & Feeney, 1979) have been shown to relate to problem tasks which appear to be similar to the biofeedback training tasks.

Given the relationships that have previously been established, it is somewhat surprising that no relationship between any of the cognitive style variables and EMG biofeedback emerged. One major difference that set the present study apart from most other studies of cognitive style variables is that no attempt was made to manipulate the levels of cognitive styles exhibited by the subjects or specifically choose subjects for participation in the study based on specific cut-off criteria on each of the cognitive style variables. In most of the studies that were reviewed, subjects were chosen on the basis of their exhibiting extreme scores on a cognitive style variable and they were then compared on how well they were able to reduce muscle tension or solve some type of problem. In light of the fact that no differences were noted between different levels of cognitive styles in their ability to predict biofeedback performance, the possibility arises that the effects noted in the prior research in this area were more an artifact of the selection process rather than a more enduring effect of any particular cognitive style variable. That is, the subjects who represent extremes on one dimension no doubt differ on a wide variety of dimensions. It would thus be difficult to attribute any particular effect solely to the presence or absence of a certain cognitive style variable.

Along a similar vein, the sample of subjects employed in this study was very homogeneous and it is apparent that the groups did not represent extremes on any of the dimensions. A possibility to be considered is that, with such homogeneity of groups, factors other than the cognitive style variables may have been affecting the biofeedback performance and may have ultimately been acting as confounding sources of variance. In effect, any small amount of variance that a cognitive style variable(or combination of variables) might have accounted for in predicting biofeedback performance would have been rendered negligible in comparison with the large unaccounted for amounts of confounding variance in the statistics. Additionally, it is possible that the subjects were simply not sufficiently different on any variables, including cognitive style, for any influences of cognitive style to be noted in their biofeedback performance.

Furthermore, the present study deviated from previous ones in its multivariate approach to the prediction of biofeedback performance. Rather than concentrating on only one or two cognitive style variables, this study employed eleven cognitive style variables in addition to the sex of subjects as potential predictors and attempted to relate them to biofeedback via a multiple regression approach. However, the present study falls short methodologically in that it employs these twelve predictors in a regression equation with a total subject population of eighty subjects. Ideally, at least ten subjects are required per predictor variable if the multiple regression analyses are to yield valid results. In an attempt to circumvent this difficulty, a factor analysis was performed which yielded four factors. When these four factors were employed as predictors in the multiple regression analyses, the results of the analyses remained essentially the same(i.e., there were no significant predictors of biofeedback obtained from this set of cognitive style variables).

The results of this study lead to two possible conclusions regarding the lack of relationship between cognitive style variables and EMG biofeedback performance. First, any effect that was noted in the previous research was as much an artifact of the subject selection process as the presence of any "real" effect solely attributable to any single cognitive style variable and that the homogeneity of groups(with the large amounts of confounding variance) in the present study negated any effect that any particular cognitive style variable may have had on biofeedback performance. Second, there were far too many variables employed as predictors for the statistical analyses to adequately handle. It should be noted, however, that the use of factor scores derived from the individual cognitive style variables also yielded no significant predictors. This second conclusion thus seems unlikely. Rather, the effects appear to be attributable to the way in which subjects were selected for participation rather than due to any particular characteristics of the subjects.

Future research in this area would benefit from incorporating a number of changes which would remedy certain shortcomings that became evident in the present study. First, subjects should be employed who exhibit wider variations on a number of characteristics, including cognitive style. This would counter the problem of not obtaining any significant effects due to the extreme homogeneity of the groups. Second, as noted in the factor analysis and the multiple regression analyses, a number of the variables employed here did not contribute significantly to either the composition of the factors or the results of the multiple regression analyses. It would be interesting to restrict the inclusion of variables to only those that emerged from the factor analysis and to delete any overlap in meaning or operational definition between variables. Finally, the number of subjects employed in the study shoud be increased to take full advantage of the power of the statistics that were used.

Effects of Biofeedback on Self-Report Measures

Contrary to expectations, the results indicated that the subjects had comparable levels of cognitive anxiety in the second session as they had had in the first. Unlike the prior research in this area, there were no overall reductions in levels of cognitive anxiety, regardless of sex of subjects or type of treatment modality involved. Furthermore, subjects did not report any increase in level of relaxation from Session 1 to Session 2. These results are interesting since it usually assumed that reports of increased relaxation and decreased anxiety accompany lower EMG muscle tension levels. As previously noted, all the subjects were able to reduce EMG muscle tension levels across sessions. However, it seems that lower EMG muscle tension levels do not constitute a necessary and sufficient condition for subjects to report increased levels of relaxation and decreased levels of anxiety.

The prior research regarding levels of anxiety and relaxation reported by subjects after biofeedback is not consistent with the results obtained in the present study. Results from previous research indicate that, for the most part, subjects who received EMG biofeedback treatment reported reductions in subjective levels of anxiety(e.g., Coursey, 1975; Alexander et al., 1977; Miller et al., 1978; and Romano & Cabianca, 1978) and increases in self-reported levels of relaxation(e.g., Reinking & Kohl, 1975; and LeBoeuf, 1980a).

While it had been expected that there would be a significant decrease in somatic anxiety across sessions, the results indicated that subjects did not exhibit less somatic anxiety after Session 2 than they did after Session 1. These results are contrary to those reported in previous literature and are consistent with the results previously reported for the cogntive anxiety variable.

An interesting finding was that subjects who did _not_ receive biofeedback had significantly lower somatic anxiety scores than subjects who received biofeedback. Even though the biofeedback subjects exhibited lower EMG muscle tension levels than the no-biofeedback subjects, they did not manifest correspondingly lower levels of somatic anxiety. It would normally be expected that subjects who maifest lower EMG levels would also report lower levels of anxiety. When subjects are treated with biofeedback, one of the aims of treatment, aside from the reduction of EMG muscle tension levels, is to increase subjects' awareness of their physiological state. By increasing subjects' awareness of their physiological state, it is hoped that they could then recognize when they are tense and move to implement techniques that would reduce tension and increase relaxation. It is generally believed that this is beneficial and is the ultimate goal of this type of biofeedback training. However, the results of this study indicate that, while subjects receiving biofeedback are able to reduce EMG muscle tension levels, they may also experience an increase in their level of somatic anxiety. This runs contrary to the accepted rationale for employing a relaxation technique such as biofeedback. It is also interesting that the subjects not receiving biofeedback (and, therefore, not as "tuned in" to their physiological state) exhibited significantly lower levels of somatic anxiety than biofeedback subjects. It almost appears that these results argue for an "ignorance is bliss" position (i.e., where what the subject is unaware of won't make him/her anxious).

On the other hand, it may be possible that an initial increase in somatic anxiety is a temporary side-effect of increased awareness. When people are asked to relax, they focus their attention on arousal and are asked to attend to their level of arousal to a greater extent than they normally do. It is not surprising, therefore, that there may be an initial increase in somatic anxiety as individuals become more aware of bodily tension. If relaxation is effective, however, this should decrease over the course of training. In a short-term study such as the present one, only the increase in arousal or somatic anxiety would be noted. If the study were extended for a longer period of time, both the initial increase in arousal and the subsequent decrease in arousal or somatic anxiety would be observed. This would require that levels of somatic anxiety be continually monitored at certain points over the course of longer treatment regimens.

These results have implications for much of the health care profession at large. There seems to be an assumption that educating the patient to the various aspects of a medical condition will prove beneficial since it equips the patient with the knowledge to recognize possible pathognomonic signs at an earlier and, thereby, prevent the occurrence of more serious damage. While this may be true, the current study lends support to the position that, while equipping the patient with preventative tools, alerting him/her to potential symptoms and/or side-effects may also unduly increase their anxiety levels. It would seem important for the health care profession to make an effort to differentiate the benefits of providing patients with this increased awareness from the detrimental costs of raising patients' anxiety levels and increasing the levels of stress that they experience.

The results from the ADACL questionnaire provided further support for the notion that this short-term relaxation training had little impact on subjective feeling of and perception of arousal. The ADACL contains four subscales, general activation, high activation, general deactivation, and deactivation-sleep, which tap into different aspects of subjects' levels of arousal. Subjects did not increase their level of general deactivation across sessions. Although there is little research relating general deactivation to relaxation techniques such as biofeedback, the assumptions underlying biofeedback and the definition of general deactivation make such a relationship very logical. Thayer(1967) described general deactivation as a state in which placidity, calmness, stillness, quiet, and a feeling of being at-rest are common. These descriptors are the feelings that would normally be expected after being treated with biofeedback. However, the results indicated that the subjects(either those receiving biofeedback or no-biofeedback) did not increase their level of general deactivation. This effect coincides with that obtained from the Cognitive-Somatic Test of Anxiety on which subjects did not exhibit greater levels of self-reported relaxation.

An interesting result that emerged from this analysis was a significant trials by modality interaction. Subjects receiving biofeedback initially demonstrated an increase in their level of general deactivation followed by a decrease at the last measurement point. The subjects who did not receive biofeedback exhibited an initial decrease in general deactivation with a subsequent increase at the final measurement. One possible explanation of these results is that biofeedback subjects initially responded to the biofeedback signal by increasing their level of general deactivation(i.e., they became more relaxed). However, as the training progressed, the biofeedback signal may have lost some of its novelty and possibly became somewhat annoying which resulted in the decrease in general deactivation. The subjects not receiving biofeedback, on the other hand, may have initially decreased their level of general deactivation because they were not given any clear direction as to how to increase their relaxation and they were experiencing some ambiguity regarding how to best utilize the treatment. As they searched for ways to become more relaxed, they felt more tense and less at peace. In the second training session, as they became more attuned to the demands of the situation and developed relaxation strategies with which they were comfortable, they increased their final levels of general deactivation.

A second possible explanation of these results is similar to that made for the somatic anxiety variable. The biofeedback subjects, in responding to the biofeedback signal and gaining more awareness of their physiological state, became more anxious about their bodies. Consequently, they were less likely to manifest those feelings that characterize a high level of general deactivation. Since the no-biofeedback subjects did not receive this constant input regarding their physiological state, they were less likely to become overly concerned or anxious during the course of training. They, therefore, were more likely to manifest lower levels of general deactivation at the termination of the treatment regimen.

Despite predictions to the contrary, subjects exhibited neither an increase in level of deactivation-sleep nor a decrease in level of high activtion across sessions. After examining the adjectives used to describe deactivation-sleep, it becomes apparent that increases in level of deactivtion-sleep might not be logically expected from biofeedback or any other relaxation treatment. Subjects who experience increased deactivation-sleep would feel drowsy, sleepy, tired, less wide-awake, and less wakeful. These adjectives are less clearly associated with the effects of relaxation treatments than the adjectives describing general deactivation. When administering a relaxation treatment such as biofeedback, having subjects becomes calm, quiet, and placid is a more reasonable expectation that to have them begin to feel sleepy, drowsy, or tired. Some subjects may express such feelings in their self-reports but the majority of subjects administered relaxation treatments would not report such feelings.

Since subjects experienced physiological relaxation(i.e., decreased EMG muscle tension levels) during the relaxation training, it would logically be assumed that they manifest some decrease in their level of high activation. The high activation factor is described by such adjectives as tense, jittery, clutched-up, intense, and fearful which, if reduced in level, would correspond to a more relaxed state. While there is nothing wrong with occasionally feeling clutched-up, tense, or intense, they are not the types of feelings that would be expected of a relaxed person. However, the results of this study failed to indicate a reduction in the level of high activation for subjects.

One possible explanation for these intriguing results centers on the inital level of high activation that subjects manifest as they enter the situation. Unfortunately, no such pre-test measures were taken in this study and the initial measurement was taken after the adaptation period in Session 1. It is possible that, whatever, their levels of high activation, subjects reduced it during the adaptation period and what was recorded after that adaptation period was not an initial baseline level of high activation but the initial level after some relaxation treatment. After reducing their high activation level in the adaptation period, it seems that there is little change or little room for change after subsequent training or adaptation periods. In connection with this, it is possible that this scale is not sensitive enough to monitor subtle changes that might occur in level of high activation across sessions. In not obtaining any modality by trials interaction, we must rule out the possibility that subjects were being differentially effected(i.e., biofeedback subjects become more highly activated while no-biofeedback subjects have lower levels of high activation) by the relaxation treatment as had been the case with the somatic anxiety variable and the general deactivation factor from the ADACL.

Contrary to expectations, the results indicated that there was an increase in the level of general activation across sessions. When subjects receive some type of relaxation training, it is expected that they would report some type of relaxed state(assuming, of course, that they manifested physiological relaxation). In this case, it would be in the form of a decreased level of general activation(i.e., less active, less full-of-pep, less vigorous, less energetic, and less lively). However, rather than a decreased level of general activation, subjects in this study reported higher levels. This presents a dilemma since it is contrary to the expected pattern of results from a relaxation treatment. Since there is no significant trials by modality interaction, these results cannot be explained on the basis of subjects becoming more "activated" in response to biofeedback treatment.

A plausible explanation for these results is that the relaxation process fostered feelings, described as general activation, in all subjects. As the subjects began to feel more and more relaxed, they, theoretically, had more of their internal resources at their disposal. In the process of becoming relaxed, subjects may feel more alert, more aware of abilities, and develop a greater sense of well-being. Consequently, it is not outside the realm of logic to expect subjects to report feeling active, vigorous, energetic, and lively, as a result of undergoing some type of relaxation treatment.

Despite predictions to the contrary, there was no significant change in cognitive appraisal of performance across sessions. There is no research regarding how subjects appraise their performance after having received some type of relaxation treatment. In light of the fact that subjects exhibited decreases in EMG muscle tension levels, it would be expected that they would have a positive appraisal of their performance. A possible explanation is that the subjects appraised their performance equally in both Sessions and, therefore, there was no change in appraisal across sessions. An alternate explanation is that, since the measure used in the present study(the CARS)(Tetkoski, Note 3) is an unvalidated instrument initially developed for use with depressed and nondepressed subjects, it cannot reliably measure changes in subjects' appraisal of performance across sessions. Therefore, even if changes in cognitive appraisal of performance occurred, they might not have been recorded by the CARS. Finally, before any changes in cognitive appraisal of performance can be registered, it is assumed that subjects detect differences in their performance from Session 1 to Session 2. If changes in performance are not perceived by the subjects, it is unlikely that any changes in cognitive appraisal of performance would reported.

The results, surprisingly, indicated that there was no difference in the relaxation strategies employed by biofeedback and no-biofeedback subjects. Qualls and Sheehan(1979), in a post-experimental interview, reported results contrary to those obtained in the current study. They focused on the types of relaxation strategies that the subjects(both biofeedback and no-biofeedback) used and the frequencies with which they were employed. They found that subjects not receiving biofeedback allowed their minds to wander, thought pleasant and relaxing thoughts, let thoughts and images drift in and out of their minds, and used imagery more frequently than subjects who received biofeedback treatment. Subjects who received the biofeedback treatment simply focused on relaxing more than did the no-biofeedback subjects. It seemed that the different demands placed on subjects by each treatment determined what type of relaxation strategies that would be employed. Since there is less demand for subjects' attention in the no-biofeedback condition, subjects have greater leeway to utilize strategies that require less consistent effort and attention. Biofeedback subjects, on the other hand, are forced by the demands of the task to focus their attention more than the no-biofeedback subjects. Consequently, biofeedback subjects will focus on relaxing(the main objective of a relaxation task) to the exclusion of other, less attention-demanding, strategies that are available to the no-biofeedback subjects.

While there were no differences in the strategies employed in the two experimental conditions, there were some differences in those employed by the males and females in this study. Females employed the strategy "Tried to intentionally have pleasant relaxing thoughts" significantly more than males. With the strategy, "Focus on my breathing", males did not exhibit any change in the frequency with which they endorsed the item across sessions while females endorsed this strategy more in Session 2 than in Session 1. Males and females did not differ in the frequency with which they endorsed any of the other eight relaxation strategies. Since males exhibited lower EMG muscle tension levels than females, it would be expected that they differ in the relaxation strategies that they employed. What is strange about the relaxation strategy results is that they do not coincide with the physiological relaxation results. The females employed two relaxation strategies more often than males and, yet, the male subjects had the lower EMG muscle tension levels. An explanation for these results is that the relaxation strategies subjects employ are not related to ability to benefit from relaxation treatment. Additionally, it may be that the relaxation strategies which were discussed here did not add anything to the effects achieved when biofeedback or instructions to relax are employed as the sole vehicles to foster relaxation in subjects.

Summary and Implications for Future Research

The results from this study confirm the effectiveness of EMG biofeedback as a means for reducing EMG muscle tension levels. It is also apparent that the sex of the subject variable is not related to the ability of subjects to reduce their EMG muscle tension levels. This study also raised the question of the overall effectiveness of EMG biofeedback as a means of influencing subjects' self-reports, particularly those reports concerned with levels of arousal, anxiety, and relaxation. Additionally, this study points to a distinct lack of data to confirm the contention that individual differences(i.e., cognitive style variables) are significantly related to subjects' abilities to benefit from EMG biofeedback treatment.

The results of this study suggest a number of areas for improvement or expansion in future research. The first change that could be made would be to include a more diverse or heterogeneous subject population while, at the same time, not selecting subjects solely because they exhibited extreme scores on cognitive style measures. It would also prove fruitful to include fewer cognitive style measures which would reduce some of the redundancy that is noted when so many similar measures are employed. In light of the fact that the particular statistics employed in this study lost some of their power with the low number of subjects, another suggestion would be to include a larger subject population in order to take full advantage of the available statistical power. Finally, a longer treatment regimen(i.e., longer than two sessions) would not only enable the researcher to obtain a more accurate view of the course of the relaxation process but also to chart the changes in subjects' self-reports of anxiety and relaxation during the treatment process.

CHAPTER VI

SUMMARY

This study was designed to investigate the efficacy of EMG biofeedback as a relaxation technique, to assess the importance of the sex of subject variable in biofeedback training, and to determine which combinations, if any, of cognitive style variables could be related to successful EMG biofeedback treatment. Subjects' self-reports of anxiety, arousal, and relaxation were also assessed at various points during and after training. Eighty introductory psychology students(forty male and forty female) from Loyola University of Chicago were administered two sets of cognitive style measures; the first set in a general survey of the introductory psychology classes and the second set, later, in group testing sessions. These subjects then participated in a 2-session biofeedback laboratory relaxation situation during which they received either EMG biofeedback with instructions to relax or only instructions to relax. Each training session was divided into a twelve minute adaptation period and a fifteen minute training period and subjects were administered self-report measures of anxiety and relaxation(Cognitive-Somatic Test of Anxiety and the Activation-Deactivation Adjective Check List) after both the adaptation and training periods of each session. Finally, subjects were asked to appraise their performance in each of

the two sessions to indicate which, if any, relaxation strategies they employed while attempting to relax.

The results from this study indicated that subjects who received EMG biofeedback treatment had lower EMG muscle tension levels than subjects not receiving biofeedback and that all subjects, to some extent, were able to reduce their EMG levels across all trials. One explanation for these differences in EMG muscle tension levels was that biofeedback subjects, by virtue of greater involvement in the relaxation process, were more motivated than the subjects who did not receive biofeedback. There were not, however, any sex differences in response to biofeedback treatment. Furthermore, there did not appear to be any cognitive style variables which could be employed as predictors of EMG biofeedback performance.

Subjects did not report decreases in cognitive anxiety or increases in relaxation while biofeedback subjects reported increases in their levels of somatic anxiety. Results from the ADACL indicated that subjects neither increased their levels of general deactivation, increased their levels of deactivation-sleep, decreased their levels of high activation, nor decreased their levels of general activation across sessions.

Finally, subjects did not demonstrate any differences in cognitive appraisal of their performance from Session 1 to Session 2 and there were no differences in the relaxation strategies employed by the subjects in the biofeedback and no-biofeedback groups.

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APPENDIX A

CONSENT FORM

Project Title: Cognitive Styles and Biofeedback Response

Sponsor: Patricia Rupert, Ph.D.

The following information is provided so that you may decide whether you wish to participate in this research project. You should be aware that, even if you agree to participate, you are free to withdraw at any time without penalty.

This study is concerned with determining the effectiveness of different types of relaxation procedures and those variables that may effect that relaxation process. As a participant in the study, you will be asked to come to this laboratory for 2 one-hour sessions. During each session, you will be attempting to relax by reducing your muscle tension. Depending on the research group to which you are assigned, we may give you some guidance and aid in relaxing. To give us an indication of your level of relaxation, we will monitor the muscle tension in your forehead throughout these two sessions. To do this, we will tape three electrodes to your forehead. These electrodes should not cause you any discomfort and will be removed much like a band-aid at the end of the session. We will also ask you to complete some brief rating scales of your feelings at the beginning and at the end of each session.

There are no known personal risks or dangers in this study. In fact, students generally find participation in this type of study to be interesting and relaxing.

You may be assured that your name will not be associated in any way with the research findings. You will be given a code number that will be used on questionnaires and muscle tension recordings. The master sheet pairing your name and code number will be kept in the locked laboratory and will be available to Mike Tetkoski, the graduate student in charge of this study. Once the study is completed, this master sheet will be destroyed.

Your participation is solicited, but is strictly voluntary. Please do not hesitate to ask any questions you might have about the study.

I have read the above description of the project "Cognitive Styles and Biofeedback Response" and I hereby consent to participate in the project.

_________________________________ _______________

Signature of person giving consent Date

_________________________________ _______________

Witness Date

APPENDIX B

INSTRUCTIONS IN SESSION 1, ALL SUBJECTS

"The purpose of this study is to investigate relaxation proceudres. Psychologists have determined through research that the ability to relax is a skill which can be acquired through practice. It has also been learned that people differ in their ability to achieve deep muscle relaxation, and also in the strategies and means that they use to help themselves relax. Through your participation in this two session laboratory experience, we are hoping to gather more information which will help us in understanding how people acquire the skill of deep relaxtion, and what methods are most suitable for differenct kinds of people. During your sessions in this laboratory, you will be attempting to relax the muscles in your body. To allow us to assess your progress in relaxing, the experimenter will attach three electrodes or sensors to your forehead. These electrodes will pick up the electrical activity in the muscles of your forehead, face, and neck. We can thus get periodic readings of your muscle tension levels.

During the course of your two sessions in this laboratory, we will be carefully monitoring your progress in attaining relaxation. It is therefore very important that you devote your full attention to relaxation. You will be asked to wear headphones throughout the course of this experiment so that background noises will not interfere with your attempts to relax. The experimenter will now attach the electrodes and answer any questions that you may have. When this has been done, you will have some time-approximately twelve minutes-to simply lean back in the chair and relax while getting used to your surroundings."

APPENDIX C

INSTRUCTIONS TO BIOFEEDBACK GROUP, SESSION 1

"We are now going to begin the relaxation training practice part of this laboratory session. We will give you approximately fifteen minutes during which to practice relaxation. You will be aided in your efforts to relax by a technique called biofeedback. It will monitor the amount of electrical activity in your forehead and facial muscles and will provide you with information about this tension level in the form of a pulsating tone. The tone will directly reflect your muscle tension. When your muscles are tense, the tone will become higher and faster. When your muscles relax, the tone will become lower and slower. Thus, you will be trying to get the tone to become slow and low. We will not give you any specific instructions on how to relax. We want you to use the information from the biofeedback to help you develop your own relaxation methods. Therefore, you should use whatever means are most helpful to you in getting the tone to go as low and as slow as possible. During this relaxtion period, we would like you to sit back, close your eyes, and relax your muscles as deeply as you can, but do not fall asleep during this time. The experimenter will be in the adjoining room monitoring and recording your muscle tension levels. The experimenter will come back into the room at the end of the fifteen minute period to give you further instructions. Now, try and relax as much as possible, without falling asleep, during the next fifteen minutes."

APPENDIX D

INSTRUCTIONS TO NO-BIOFEEDBACK GROUP, SESSION 1

"We are now going to begin the relaxation training practice part of this laboratory session. We will give you approximately fifteen minutes during which to practice relaxation. We will not give any specific instructions as to how to relax, because we find that people are able to develop their own effective relaxation methods. During this relaxation period, we would like you to sit back, close your eyes, and relax your muscles as deeply as you can, but do not fall asleep during this time. The experimenter will be in the adjoining room monitoring and recording your muscle tension levels. The experimenter will come back into the room at the end of the fifteen minute period to give you further instructions. Now, try and relax as much as possible, without falling asleep during the next fifteen minutes."

APPENDIX E

SEMANTIC DIFFERENTIAL SCALE

Place a check mark in the appropriate segment to indicate how you would describe THE EXPERIMENTER(the person who hooked you up to the electrodes and took all the readings):

Pleasant	____:____:____:____:____:____:____	Unpleasant
Deep	____:____:____:____:____:____:____	Shallow
Worthless	____:____:____:____:____:____:____	Valuable
Active	____:____:____:____:____:____:____	Passive
Boring	____:____:____:____:____:____:____	Interesting
Good	____:____:____:____:____:____:____	Bad
Weak	____:____:____:____:____:____:____	Strong
Fast	____:____:____:____:____:____:____	Slow
Tense	____:____:____:____:____:____:____	Relaxed
Light	____:____:____:____:____:____:____	Heavy
Hard	____:____:____:____:____:____:____	Soft
Cold	____:____:____:____:____:____:____	Hot
Refreshing	____:____:____:____:____:____:____	Tiring
Uneffective	____:____:____:____:____:____:____	Effective

APPENDIX F

RELAXATION STRATEGIES QUESTIONNAIRE

Please rank ONLY those strategies which you actually used in your attempts to relax during this experiment. If one of the criteria applies to you, circle the number next to it indicating how helpful it was in bringing about deep relaxation:

1 hindered my relaxation a great deal

2 hindered my relaxation a little

3 neither hindered nor helped me to relax

4 helped me to relax a little

5 helped me to relax a great deal

Please do not feel that you must circle a number for each strategy listed.

Circle a number below ONLY for those strategies used during your First Session:		Circle a number below ONLY for those strategies used during your Second Session:
1 2 3 4 5	Focus on my breathing.	1 2 3 4 5
1 2 3 4 5	Focus on relaxing.	1 2 3 4 5
1 2 3 4 5	Tried to intentionally have pleasant relaxing thoughts.	1 2 3 4 5
1 2 3 4 5	Tried to let my mind wander by itself.	1 2 3 4 5

1 2 3 4 5	Tried to let my mind go blank.	1 2 3 4 5
1 2 3 4 5	Let thoughts and images drift in and out of my mind.	1 2 3 4 5
1 2 3 4 5	Simply thought about whatever came into my mind.	1 2 3 4 5
1 2 3 4 5	Used images, or pictures of things in my mind.	1 2 3 4 5
1 2 3 4 5	Used a sense of rhythm.	1 2 3 4 5
1 2 3 4 5	Saw blackness or colors.	1 2 3 4 5

Please describe here any method which you used to help yourself that may not have been described above:

Which session did you enjoy most?___First session or ___Second session.

During which session do you think you actually relaxed most deeply?

___First session or ___Second session.